Einstein and the popular image of science in the Netherlands

The Dutch reception of relativity theory in the aftermath of the First World War

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1. Introduction

The reception of Albert Einstein's relativity theory is one of the most popular topics in the historiography of modern physics. The number of publications on the history of relativity is astonishing, while the field is split up in a wide range of specific topics, including scientific receptions from a nationwide scale to single scientists, public reactions in specific countries, and detailed studies on Einstein's most ardent critics.[1] Not much attention has however been paid to the reception of relativity in the Netherlands. Some authors have touched upon the subject, but no more than two studies have addressed the reception of relativity in the Netherlands directly. The first, by A.J. Kox, describes specifically the forming of a research group in general relativity in Leiden, and adds a short discussion of Dutch anti-relativists in an appendix;[2] the second, Henk Klomp's PhD dissertation, does elaborate on the overall reception in the Netherlands, but mainly focuses on the influence of relativity theory on intellectual culture, and especially emphasizes its impact on educational reform.[3]

Recent studies on the reception of relativity have shown that the adoption and dissemination of Einstein's theory cannot simply be considered as a logical step in the development of modern physics. The spread of relativity was not at all self-evident, and in many countries, Einstein's theory was largely ignored for decades after its initial publication. This insight calls for rigorous enquiries into why, how and when people reacted to relativity, enquiries which take into account both historical scientific contexts as well as socio-political factors: such a study as yet does not exist for the Dutch case.[4] The lack of a general account on the reception of relativity in specifically the Netherlands is quite remarkable, as Leiden physicists Hendrik Lorentz en Paul Ehrenfest were not only close friends of Einstein, but also major contributors to his theory in the early 1910s. Furthermore, their colleague Willem de Sitter was responsible introducing the theory of general relativity in Britain during World War I, and would become Einstein's main challenger in debates concerning general relativity and cosmology in the period around 1920.[5] Moreover, Einstein himself was appointed as 'special professor' in Leiden in 1920; because of that appointment and his close personal contacts with several of Leiden's physicists, Einstein felt that he had a clear bond with the Netherlands.[6]

Besides the obvious importance of Dutch physicists in the history of relativity, the reception of Einstein's theory in the Netherlands is also interesting for other reasons. Several authors have indicated that *public* reactions to relativity theory in the Netherlands differed from those in Germany, England and France. A.J. Kox for instance has remarked that "even Dutch anti-relativists remained polite and avoided personal attacks";[7] Leiden's Museum Boerhaave, in an exhibition on *Einstein and the Netherlands* in 2005, concluded from a private collection of

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[1] For instance: Warwick in, "Cambridge Physics" and *Masters of Theory* discusses the scientific reception in Cambridge and Britain; Walter, "Minkowski" describes reactions to relativity amongst German mathematicians; Goenner, "Reaction to Relativity", Rowe, "Einstein's Allies", and Van Dongen, "Reactionaries and Einstein's Fame" discuss Einstein's opponents in Germany in the early 1920s and Einstein's reaction to them, while Wazeck, *Einsteins Gegner*, discusses international anti-relativity movements; Price, *Loving faster than light*, describes the overall public reaction to the theory in Britain, focusing on its influence on popular culture.

[2] Kox, "General Relativity".

[3] Klomp, *De Relativiteitstheorie*.

[4] Recently, the editors of a volume on the spread of 'Newtonianism' in Holland have similarly argued that their subject deserves more attention for the exact same reasons; see Jorink & Maas, "Introduction".

[5] De Sitter's involvement with relativity theory is discussed in Röhle, *Willem de Sitter*.

[6] Van Dongen, "Mistaken Identity"; Kox, "Einstein and Lorentz".

[7] Kox "General Relativity", pp. 46-47.

newspaper clippings that "Einstein was *not* surrounded by great controversies" in Holland, and that "he was already a celebrity in the collection's first clippings in 1920".[8] Although the museum's collection is not systematic, it indeed makes clear that Einstein was popular in the Netherlands: much attention was paid to Einstein's personal life, as for instance his appointment in Leiden and his flight from Germany in 1933 were extensively covered, and many reminiscences of Einstein's life and work were published in the years after his death.[9]

The absence of controversies in the Dutch reception of relativity is indeed remarkable and deserves further explanation. The situation in Holland distinctly contrasts with that in the former belligerent countries, where public receptions of relativity were very much impeded by the First World War and its consequences. Anti-German sentiments played a major role in the popular response to Einstein's work in Allied countries. International scientific collaboration had largely broken down, not in the least because of the Manifesto of the 93. The Manifesto, which was signed in 1914 by many leading German scholars, denied Germany's wrongdoings in the war, and was met with indignation in Allied countries. In France and Britain, Einstein was seen by many as exponent of despised 'German science'. In Germany itself, Einstein was a controversial figure because of his pacifist ideals and his Jewish background, which both provoked strong reactions from conservative and reactionary critics. Furthermore, Einstein and his theory of relativity personified 'modern physics', which, according to its opponents, would not lead to a true understanding of nature as it valued complex mathematics above experience and common sense. Especially amateur scientists and experimental physicists felt threatened by the expanding influence of the new physics.

The resistance within those groups and their subsequent marginalization even led to the establishment of anti-relativity movements in Germany and the United States.[10] Einstein, reacting to a rally of such a movement in 1920, where his work had been denounced as 'Dadaist physics' and he himself had been accused of plagiarism and propaganda, wrote in the *Berliner Tagblatt*: "I have good reason to believe that motives other than the striving for truth are at the bottom of this business. (If I were a German nationalist with or without a swastika instead of a Jew with liberal international views, then…)"[11]. Dutch society on the other hand was significantly less disrupted by the war and its aftermath. The Netherlands had actively maintained its neutrality, a position generally favoured by the public opinion.[12] Therefore, strong nationalistic sentiments were of little importance compared to those in the former warring countries. In the Netherlands, reactionary critics of relativity certainly did not overshadow the popular reception of relativity. That being the case, the Dutch popular reception of relativity could be helpful in interpreting popular reactions to the theory in a wider sense, without the obvious focus on its most ardent critics.

Between 1902 and 1913, no less than five Dutch scientists won a Nobel Prize, including the physicists Hendrik Lorentz, Pieter Zeeman, Johannes Diderik van der Waals and Heike Kamerlingh Onnes. This constitutes another possible reason for a positive reception of relativity,

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[8] Maas, *Einstein in de krant*, p. 2.

[9] *Ibid*. In the introduction, Maas gives a short overview of the content of the museum's Einstein collection. The clippings are part of the 'Krooncollectie' of Museum Boerhaave. The collection exists mostly of unclassified single clippings over the period 1920-1970 and from a wide range of newspapers and magazines. I thank Ad Maas for his help in examining and permission to access this collection.

[10] The most thorough account on the opponents of relativity theory is Wazeck, *Einsteins Gegner*. On anti-relativists in Germany, see also the articles by Goenner, Rowe, and Van Dongen in note 1. For France, see e.g. Van Kimmenade, *Resistance* and Biezunski, "Einstein's Reception", for Britain, see e.g. Stanley, "Expedition".

[11] Einstein, "Meine Antwort", cited in Van Dongen, "Reactionaries and Einstein's Fame", p. 212.

[12] Abbenhuis, *Staying Neutral*, Tames, *Oorlog*.

as it seems likely that these successes created an atmosphere that was sympathetic towards the natural sciences, especially physics.[13] The reception of relativity therefore also provides an excellent opportunity to clarify the relations between science and society and study public opinion on science: relativity was highly visible in the media, while at the same time Dutch physics was very successful.

This interplay between science and the public is however a somewhat neglected topic in the historiography of Dutch science. The historiography of the Dutch interwar period has in general focused on the 1930s. Furthermore, studies on the image and role of science in the period under consideration have almost exclusively concentrated on the positions taken by scientists themselves.[14] The reason for that is that many Dutch scientists had very outspoken views on the role of science in society, and tried to legitimize their work by pointing out the applicability and utility of science. The responsibilities and role of universities were therefore recurring themes in scholarly debate. Especially the alleged separation between society and the 'ivory towers' of academic research played a central role in these debates.[15] As the theory of relativity could hardly be considered of practical use, another interesting question is how physicists working on the theory would actually legitimize their efforts, and whether the public would appreciate this perfect example of ivory-tower-science. Was the legitimacy of fundamental work on relativity challenged?

This study on the reception of relativity theory in the Netherlands will hopefully cast light on several issues. First, I will examine the factors that shaped the Dutch reception. In order to determine which of these factors were particular for the Netherlands, I will compare the Dutch reception with well-known receptions of relativity in Britain, France and Germany. Analysing resemblances and differences with familiar stories will help to put the Dutch reception of Einstein's work in context. The distinct reception of relativity in the Netherlands will, in all probability, be partly due to the influence of Dutch physicists; their influence on the public reception will be studied in detail. The reception of relativity will thus also enable me to construct an image of the relations between physicists and the public in the period under consideration. This image, in turn, will be used to draw more general conclusions about the interactions between scientists and society in the Dutch *Interbellum*.

The main part of this thesis comprises an analysis of Dutch reactions to relativity. This analysis ranges from newspaper articles and essays in literary journals to the application and propagation of relativity by Dutch scientists. Although Einstein's 1905 theory of special relativity was discussed in public in the Netherlands as early as 1909,[16] the focus here will be on the early 1920s. Public interest in the theory of relativity became serious only after its dramatic 'confirmation' by an eclipse expedition by British astronomers in 1919, which turned Einstein into the international celebrity he still is today. As the interest in Einstein and his work declined during the mid-1920s (but still remained remarkably high), the emphasis will be on the period 1919-1923.

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[13] The successes of Dutch science in the first decades of the twentieth century have been explained by referring to 'bourgeois scientism' and educational reforms inspired by that scientism; see Willink, *Burgerlijk sciëntisme*.

[14] For instance Baneke, *Synthetisch Denken*, discusses the views scientists had on the relations between science and society during the first part of the twentieth century. Although Baneke too criticizes the focus on the 1930s – see p. 12 – he himself does not write much about the 1920s either. Nonetheless, *Synthetisch Denken* is as yet the most elaborate account on the Dutch relations between science and the public in the interwar period.

[15] See for instance Knegtmans, "Universiteit en Samenleving", p. 13.

[16] Van der Waals jr., *Meest fundamenteele wetten*.

As discussed, special attention will be paid to the influence of Dutch scientists and their popularizing work, as they of course played an important role in shaping the public reception. Einstein's appointment in Leiden in 1920 was in part politically motivated – as Jeroen van Dongen has indicated, Einstein's own political ideals of pacifism and internationalism resonated well with the politics of the Dutch Royal Academy of Sciences, which, with Lorentz as one of the key figures, aimed to position Dutch science as a mediator in reconciling deteriorated international scientific relations after the First World War.[17] I will also discuss in detail how the politics of Lorentz, Einstein and others involved affected the popular reception of relativity theory and its creator. However, before the reception of relativity and public images of science can be appreciated, both a perspective on the Dutch socio-political situation in the 1920s, and an introduction in the historiography of the reception of relativity are necessary.

'Pillarization' and science in the Interbellum

In spite of the fact that the Netherlands remained neutral during the First World War, the war did of course affect Dutch society. The Netherlands, however, did not have to face some of the main problems of the warring nations, such as significant numbers of war casualties and a severely disrupted economy. In fact, some sectors of the Dutch economy, most notably agriculture and international trade, were able to reap significant benefits from the war by supplying a deprived Germany.[18] This relative prosperity persevered in the period after the war, leading to a decrease in income inequalities.[19] The lower classes clearly benefitted. They acquired both economical and political power due to the introduction of universal suffrage for men in 1917 and for women in 1919. This democratization was in fact part of the 'Pacificatie', an agreement between all important political parties which regulated the most pressing problems of Dutch society and stabilizing Dutch politics for decades to come.[20] In clear contrast with for instance Germany, Holland was politically stable and economically prosperous in the early 1920s.

As a consequence of the universal right to vote, what had already been a main cultural characteristic of turn-of-the-century Netherlands would become even more pronounced politically after World War I. The state of Dutch society during the interwar period was dominated by so-called 'pillarization' (*verzuiling*). Practically, this meant that the population of the Netherlands was divided into ideological and religious groups, each with its own elites and popular bases. In this "socially and ideologically fragmented system",[21] Protestants, Catholics, Liberals and Socialists all had their own political parties, labour unions and newspapers, which reduced the need for communication between different communities to a minimum. This process of pillarization had already been set in motion in the late nineteenth century, but the liberal idea of extending the right to vote to the whole population led to an upswing of confessional, and to lesser extent, socialist parties.

Although the pillarization hugely influenced society during the interwar period – even the universities were divided, with the Vrije Universiteit in Amsterdam having a Reformed (orthodox Calvinist) background and a Catholic university being founded in Nijmegen in 1923 –

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[17] On the motivation and details of Einstein's appointment in Leiden, see Van Dongen, "Mistaken Identity", on the post-war efforts at international mediation of the Dutch Academy, see Otterspeer & Schuller tot Peursum-Meijer, *Wetenschap en wereldvrede*.
[18] Van Zanden, *Een klein land*, p. 128.
[19] *Ibid.*, p. 140.
[20] Lijphart, *Politics of Accommodation*, pp. 110-112.
[21] *Ibid.*, p. 1.

its influence on the natural sciences should not be exaggerated. The authoritative *Algemene Geschiedenis der Nederlanden* notes that "understanding the pillarization in the Netherlands is more important for someone trying to get an impression of the artistic setting in the interwar period than for someone trying to appreciate academic life. Especially for the natural sciences, specific Dutch backgrounds were less consequential than they were in art and particularly in literature".[22] Additional evidence for this claim is the fact that especially natural scientists of the Reformed Vrije Universiteit, which was in many other facets quite isolated from other universities, started to collaborate with their colleagues from other universities almost immediately after their department was established in 1929.[23] Even though these scientists had to subscribe to a strong Calvinist doctrine, the department of natural sciences of the Vrije Universiteit "became an accepted part of the Dutch scientific world".[24]

Taking this into consideration, the exact impact of the pillarization of Dutch society on the reception of relativity remains to be investigated. The above suggests that scientists themselves were not considerably influenced in their work by their ideological or religious backgrounds. This indicates that at least the scientific reception of relativity theory would not show considerable differences between those groups. This, however, does not necessarily have to apply to the public reception. In his dissertation on relativity theory in the Netherlands, Henk Klomp has in fact discussed the reception of relativity theory separately for different ideological groups. Klomp devotes two chapters to the reception of relativity among Liberal, Reformed, Catholic, and Socialist 'intellectuals'. Klomp nevertheless has difficulties with finding ideologically coloured reactions from in particular Reformed and Socialist circles.[25] This implies that it is not at all evident that a division along ideological lines is helpful in describing the reception of relativity theory in the Netherlands. According to a sociological study published in 1933, the propagation of scientific information was in fact one of the main causes of the diminishing influence of religion in the Netherlands; science therefore undermined the ideological separation of the Dutch population. Due to scientific concepts, 'the people' could understand more without invoking God, and could use science as a substitute for religion.[26]

Beforehand, it is not at all self-evident that any social demarcation would be useful in explaining the reception of relativity. As Barbara Allart has shown, in the late nineteenth century popularization of science was in fact used to unite science and religion in the Netherlands. But, there were also many similarities between popularizations of different 'pillars'. In fact, Allart has argued, science could be used to defend any point of view: opinion leaders belonging of distinct pillars would just adapt their scientific rhetoric to their political points of view.[27] Thus, I believe that when 'pillarization' would be used as a scaffolding here, the interpretation of the reception of relativity would almost inevitably be directed towards already well-known divisions in Dutch society. That differences in the reactions to science between for instance Socialist and Reformed communities did exist, does not mean that these differences are helpful in explaining the

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[22] Van Galen Last, "Cultureel-maatschappelijk leven", p. 301: "Een inzicht in de verzuiling van Nederland is noodzakelijker voor wie een indruk wil krijgen van het artistieke klimaat tussen de beide wereldoorlogen dan voor wie het academische leven wil kennen. Vooral voor de natuurwetenschappen waren de specifieke Nederlandse achtergronden van minder invloed dan voor de kunst en vooral de literatuur."
[23] Flipse, "Science-Religion Conflict", p. 377.
[24] *Ibid*., p. 378.
[25] Klomp, *De Relativiteitstheorie*. See especially chapter 4, "Einstein en de verzuiling", pp. 97-118. Only one Reformed intellectual directly reacting to relativity theory is cited, and Klomp's chapter on the socialist reception consists of one person's reaction. Klomp acknowledges this incompleteness, but nevertheless tries to give a typical description of the reaction of each ideological group, see p. 97.
[26] Kruijt, *Onkerkelijkheid*, p. 244.
[27] Allart, *De wetenschap*.

reactions to relativity. Of course, cultural leaders of distinct groups did adapt their rhetoric to their respective audiences. This however does not necessarily imply that there will be fundamental differences in their evaluations of the theory of relativity when one looks beyond this ideological rhetoric. More likely, and as has been noticed by Allart, their rhetoric will point to a difference in the role they were willing to attribute to science. I will come back to this issue in the concluding sections, after having discussed the relevant reactions to relativity theory.

Popular science and receptions of relativity theory

Although one has to be careful with social demarcations in general, in the case of the reception of relativity theory, the 'public' or 'popular' reception actually does have to be separated from the reception among physicists and mathematicians working on the theory. However, such a demarcation would be in contrast with recent historiography on 'popular science', as the usefulness of notions like 'public science' and 'popularization' has been questioned recently.[28] I agree with these accounts that gradual differences between distinct 'popular audiences' can and in fact do undermine the notions of 'experts' and 'public'. Of course, using the term 'popularization' for both a lecture on relativity held for instance for a group of chemists or engineers as well as for an address to a general public of a certain newspaper, gives rise to certain problems and ambiguities. In order to overcome these problems, James Secord, in 2004, has made the sweeping proposal to consider both making and popularizing knowledge as a form of communicative action.[29] This proposal would circumvent pointing to essential differences between science and the public where there are in fact only the gradual differences between experts and laymen, and put more emphasis on the "author, narrator, text, work, and readers" of a certain address.[30]

Notwithstanding the fact that many of these arguments are legitimate and should be taken into account, I will demarcate the scientific reception of relativity in the Netherlands from the public reception. The reason for this is the simple fact that the scientific reception of relativity preceded public interest in Einstein by roughly a decade. The professional debate on relativity was largely settled in the Netherlands when public interest flared up. The scientific and public receptions of relativity are therefore temporally separated, but there is also a fundamental difference between the two. As we will see further on, the term 'relativity' was already widely in use in science before Einstein's work became influential. The key part in understanding the scientific reception of relativity is the *interaction* between scientists' own work and the new theory of relativity. In order to understand how scientists reacted to relativity, research programmes of these scientists have to be taken into account. It is not in any way self-evident that scientists should react positively to a new theory, or even that they should react at all. Assuming that scientists had to respond to Einstein's relativity, presupposes the idea that Einstein's work somehow occupied a special position, which it of course did not until *after* its acceptation.

Andrew Warwick has shown that this was exactly the case for British reactions to relativity theory: Einstein was largely ignored until after the First World War, as British theorists had a different idea of the concept 'relativity'. Einstein's work simply did not fit in with their research programmes.[31] 'Relativity' did not refer specifically to Einstein's theory in Britain

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[28] See for instance Cooter & Pumfrey, "Separate spheres"; Topham, "Rethinking" and "Introduction".
[29] Secord, "Knowledge in Transit". For an interesting discussion of different 'steps' between expert and lay audiences, see Nikolow & Schirrmacher, "Wissenschaft und Öffentlichkeit", pp. 27-31.
[30] *Ibid*., p. 662.
[31] Warwick, "Cambridge mathematics", especially pp. 626-631; see also Warwick, *Masters*, p. 443.

before the war, as it already did in Germany and the Netherlands. In that sense, as discussed by Richard Staley, scientists are 'participants' in the forming of the notion of 'relativity theory'.[32] Staley has clearly shown that in Germany, early proponents of Einstein's theory actively adapted both the meaning and the history of 'relativity theory' to facilitate the acceptation of the Einstein's work. In 1905, when Albert Einstein published what has become known as the 'theory of special relativity',[33] the concept 'relativity' did not especially relate to Einstein's work. The title of Einstein's article did not include that term, and when German physicists spoke of relativity, they often referred to Hendrik Lorentz' work as much as they referred to Einstein. The 'theory of relativity' was attributed to Einstein alone only after 1911.[34]

As will become clear later on, relativity became popular among the Dutch public only after the 1919 eclipse expedition, while early popularization started in 1913, which, as will be shown, was also *after* most prominent physicists had at least partially accepted relativity as a viably theory. In contrast to the scientific reception, the public reception of relativity theory therefore really commenced after the notion 'relativity theory' became equivalent to Einstein's work on the subject. Because of that, the 'public', in the sense of all non-specialists on either theoretical physics or some closely related discipline, could only react to what scientists had already rigidly defined as 'Einstein's relativity theory' (and were expected to accept it without reserve), and therefore played a very different role in the reception of relativity than the 'experts'. Where for the experts, one needs to explain why they reacted to Einstein's theory, public attention to relativity theory was a logical consequence of popular accounts on the theory given by scientists. The professionals *were* of course responsible for introducing relativity to the public. Therefore, the reception of relativity can be loosely divided into three periods: the 'scientific reception' which was completed around 1913; popularization – mainly 1913 to the beginning of mass interest in 1919 – and the peak period of public interest, roughly 1919-1923.

The fact that public interest in relativity was caused by expert popularization, does not mean that the popular reception followed a simple 'diffusionist model' of scientific popularization, where knowledge would merely trickle down from 'science' into 'popular culture'. Of course, public audiences did have an impact on the reception of relativity theory, but these influences played a role at a social level instead of a scientific level. The Dutch public was especially involved in determining in what parts of cultural life relativity theory could become important. The main question in the study of the popular reception of relativity is therefore how the public perceived Einstein and relativity theory: what did they think of Einstein, and how was relativity theory used in popular culture?[35] The transmission of scientific knowledge from experts to the public, as Roger Cooter and Stephen Pumfrey have strongly argued, is not simply the imposition of dominant knowledge on a lay public; *both* the interests of the popularisers – mainly the authority of their work – *and* those of their audience have to be considered,[36] even if the latter are much more diverse, vague and ambiguous. Only when the popular transmission and consumption of science are taken seriously, can the reception of relativity clarify the public status of science.

These arguments on the role of audiences in popular science, as well as the above idea to replace the notions of 'popularization' and 'popular science' by 'scientific communication', have all been made in the light of recent studies into the role of 'popular science' in particularly the

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[32] Staley, "Histories of Relativity", pp. 266-268.
[33] Einstein, "Zur Elektrodynamik".
[34] Staley, "Histories of Relativity".
[35] For a similar point of view, see Price, *Loving faster than light*. Price discusses the reception of relativity in Britain as a "cultural resource". Her perspective differs from mine in that I try to describe the popular status and role of science in society in general, while she focuses on its cultural influence specifically.
[36] Cooter & Pumfrey, "Separate spheres".

nineteenth century. Although many of these arguments retain their value in studies on the twentieth century, the predominance of work on the nineteenth century in the historiography of popular science of course has consequences for the study of popular science in general. It would be of interest here to reflect on the differences between the role of popular science in the nineteenth and popular science in the twentieth century. However, as has been argued repeatedly in recent years, little is known about the "transformation of popular science" in the early twentieth century.[37] Yet, this period is certainly important. Firstly, as discussed in the previous section, the role of the 'public' was subject to change. With the implementation of universal suffrage in the early twentieth century, 'the masses' probably would have seemed a much more interesting audience than they had been before. But, as will be discussed in the next chapter, profound institutional developments too took place in Dutch science: science became much more specialized and professionalized, and at the same time, the universities saw an increasing influx of students, especially from middle classes.

Because of the professionalization and specialization, science became much more technical, and creating mutual understanding between scientists and their public became more difficult. This however did not necessarily mean scientists were less willing to popularize their knowledge, as Peter Bowler has shown for the British case.[38] In the Netherlands too, popularization of science seems to have been very important to scientists, mainly as an attempt to bridge the gap between science and the public that arose from further specialization of the sciences.[39] This 'gap', according to Bernadette Bensaude-Vincent, in fact was mostly created by developments in modern physics and its use of complex mathematics. Together with the creation of this gap, Bensaude-Vincent has argued, 'modern physics' was also responsible for a new understanding of public knowledge, namely an understanding in which there was a clear-cut demarcation between unreliable public knowledge based on 'common sense' on the one hand, and "sacramentalist" expert science on the other. Because of that, the new physics would have disqualified public knowledge entirely.[40]

Although this assertion might seem a bit strong, this is more or less how certain German critics of the theory of relativity observed these developments. As Milena Wazeck had described in her dissertation *Einsteins Gegner*, a significant part of German opposition to relativity theory came from non-academic 'scientists'. These people in general had been trained in the natural science, medicine or engineering, but had not been able to attain an academic position. In their own perception, however, this did not make them any less scientists than their colleagues at the universities. In fact, these non-academics felt that *they* were the real scientists, as they had not succumbed to the degeneracy of specialization. Unfortunately for these *Welträtsellöser*, as Wazeck calls them, German academics did not agree with that: subsequently non-academic researchers were constrained to the fringes of science. Because of that they felt marginalized, and, according to Wazeck, subsequently developed an anti-academic attitude.[41] A similar situation could be found by German experimental physicists, who felt threatened by the growing influence of theoretical physics. Both non-academic as well as experimental opponents of

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[37] For instance: Daum, "Varieties of Popular Science", p. 327, and Bowler, *Science for All*, pp. 1-12. Daum also argues that the field of the study of popular science is "imbalanced" by a dominant focus on Britain, see p. 322. An example of disregard of the early twentieth century, probably because of a lack of literature on that period, is Van Lente, "Publieke beeldvorming". Van Lente, in 2005, discussed recent developments in the historiography of science with an explicit focus on the Netherlands, but largely confines himself to the nineteenth and post-World War II twentieth centuries.

[38] Bowler, *Science for All*.

[39] Van Berkel, "Oude en nieuwe universiteit", p. 185.

[40] Bensaude-Vincent, "A genealogy", in particular pp. 107-108.

[41] Wazeck, *Einsteins Gegner*, in particular pp. 27-33.

relativity felt that both their role in science and their social positions were being marginalized. Both these groups developed a defensive or even reactionary attitude. In Germany as well, relativity became highly visible after 1919, and, as Wazeck shows, this made Einstein's theory an excellent target for the marginalized groups to aim their attacks at. The notion of 'common sense' became explicitly involved in their attacks, as relativity's opponents argued that the theory had substituted it for mathematical complexity.[42]

Wazeck' work on the opponents of relativity theory is certainly interesting. Wazeck has studied their reactions bottom-up, which enables her to identify the aims and positions of Einstein's opponents on an individual level. Such an approach gives the means to connect individual reactions to a more general public perspective on science, and is therefore very helpful here. In contrast to Wazeck's research, which discusses particularly negative reactions to relativity, whether these were influential or not, this thesis gives a more general overview of public reactions in the Netherlands, so that a more balanced account of relativity's reception will be formed. Because of the absence of vehement attacks on relativity theory – Dutch critiques of relativity were in general much more nuanced – a division between positive and negative reactions to relativity is hardly possible. Besides that, I believe that negative, or in the Dutch case reserved reactions to relativity theory, could be much more helpful to the understanding of the role and perception of science when they are discussed in the context of a more general reaction to the theory. I will reconstruct this 'general reaction' to relativity by an analysis of coverage on Einstein and his theory in newspapers and cultural journals. This will provide a scaffolding for our image of science in the Netherlands, which will be further elaborated on by an analysis of extended critiques of relativity. These critiques, also in the Netherlands, were written mostly be people on the 'fringes of science'. Studying these authors on the fringes and their perception of institutional science can of course be very helpful in determining the role of science and universities, and will cast light on public opinion on science.

As the mass reaction to Einstein's turned the reception of relativity into a, if not *the* major topic in popular science in the 1920s, the reception of relativity cannot be studied in a context wherein the role of popular science remains stable. Although it must be analysed in the context of existing views on popular science, the reception of relativity and the furore it aroused have almost certainly had a significant influence on popular science in general. Therefore, we need an image of popular science where neither the reception of relativity is caused by the public opinion, nor that opinion is exclusively interpreted from the reactions to relativity. We need an image where there is interdependent development between public images of science and the reception of relativity theory. The extent to which it is possible to form such an image from a limited study is questionable; nonetheless, I will try to formulate some preliminary ideas in the conclusion. In order to make that possible, I will focus not only on the most outspoken responses to Einstein's work, but on the most influential ones, that is, reactions to relativity in the most important newspapers and journals. The scientific reception of relativity will be discussed in chapter three, with the early popularization and public reactions to relativity being the subject of chapter four. Chapter five will give an overview of the 'general' public reception of Einstein and relativity in the early 1920s, while chapter six focuses on more articulated reactions and uses of relativity theory, and will thus also comprise an analysis of the fringes of science in the Netherlands. In order to relate the public reception of relativity to the debate on the role of science in the Dutch interwar period, an introduction in that debate is required. The next chapter provides that introduction, as it focuses on the role of science and the relations between science and the public in the first decades of the twentieth century.

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[42] *Ibid*. See also Wazeck, "Marginalization Processes".

2. Science and society in the Netherlands

Although, as we have seen, the exact impact of ideological fragmentation in the interwar period on science has yet to be clarified, social developments and science of course influenced each other. Science was, certainly in that period, a major part of Dutch culture. As historians of science have approached the relations between science and society almost exclusively from the vantage point of science, while cultural historiography largely ignores the role of science, there are, as discussed, clear shortcomings in the current literature on the role of science. We know what scientists thought, but how was that related to 'public opinion'? With the public reception and popular image of science I will describe in this thesis, a more balanced impression of the relations between society and science can hopefully be constructed. This chapter will give an outlook on the scientists' side of the story: it will discuss what we in fact do know about the public image of science in the first decades of the twentieth century. However, as the shear size of the public interference with relativity indicates that relativity had a huge impact on the relations between science and its audience, this chapter will not suffice as 'context' of the reception of relativity. Instead, it will be the starting point of its discussion.

The general consensus among historians is that the *fin-de-siècle* was a period in which Dutch culture and science flourished. At the same time – and this was for contemporaries not a mere coincidence – social progress was accomplished and prosperity grew. It has been asserted that "this period of scientific flourishing [...] around 1900, mirrors the great prestige science and scholars enjoyed at that time".[43] A 'modernistic' faith in science and technology was not something particularly Dutch: this attitude was common to the whole Western world, mainly a consequence of the electric revolution. Dutch science *was* however especially successful in this period, and was held in high regard internationally. This is illustrated by the five Nobel Prizes won by Dutch scientists in the period 1901-1913.[44] Scientists were important cultural figures in Dutch society; leading newspapers for instance regularly published summaries of academic lectures. Historians have claimed that "of this international reputation, both in mathematics as in the natural sciences, the educated part of the Netherlands was assuredly aware in the period 1920-1940".[45]

Traditionally, the First World War is considered a turning point in Western European culture. It is seen as the end of an international period of faith in science, and the origin of anti-scientific sentiments most famously embodied in Oswald Spengler's *Untergang des Abendlandes*. However, several authors have argued that specifically in the Netherlands, World War I did *not* entail a clear break in intellectual debates and modernistic thinking.[46] This of course is related to the fact that the Netherlands remained relatively stable and prosperous during and right after the war. Clear anti-intellectual sentiments did not gain significant weight before the economic crisis of 1929. But, even in Belgium, which suffered severely during the war, pessimistic views on science did not attain wide support in the 1920s.[47] According to historian of science David

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[43] Van Lunteren, Theunissen & Vermij, *Opmars van Deskundigen*, p. 18: "De bloeiperiode die de wetenschap [...] rond 1900 doormaakte, weerspiegelt het grote prestige dat de wetenschap en haar beoefenaren indertijd genoten".

[44] See e.g. Van Berkel, "Stuwende kracht", and references therein.

[45] Van Galen-Last "Cultureel-maatschappelijk leven", p. 290. "Van deze internationale reputatie, zowel in de wiskunde als in de natuurwetenschappen, was het ontwikkelde deel van Nederland zich tussen 1920 en 1940 terdege bewust."

[46] Baneke *Synthetisch Denken*, pp. 28-45. De Jong & Van Lunteren argue precisely that the war was not an important breakpoint in the Dutch philosophical climate, "Fokkers Greep", p. 14.

[47] Onghena, "Survival".

Baneke, cultural pessimism in the Netherlands arose not so much after World War I, but after the economic crisis in 1929 instead. Therefore, a genuine 'cultural break with the past' can be identified more with the crisis than with the war (the war of course *had* been the cause of the cultural break in for instance Germany). Cultural pessimism was mainly a reaction to the 'dilemma's of modernity'. In Holland, science was not only considered as a main constituent of modernity and its problems, but also as a possible solution.[48]

The economic breakdown probably affected the Dutch public opinion on science too. In an influential study of 1968, sociologist A.A de Jonge has identified a 'small crisis of democracy', in the Dutch Interbellum, which mostly consisted of a growing anxiety about the effectuation and consequences of the democratic system. After the Pacificatie of 1917, the role of the state in public affairs had grown, causing an increased bureaucratization of the political system. This, coupled to the state's actual inability to cope with the problems of the new democratic system during the 1920s, led to this 'small crisis'. Although this crisis was already simmering during the first years after the First World War, its full effect became visible only after the economic breakdown, when the supposed political failure became tangible.[49] As Baneke suggests, this anxiety also affected the universities, as they pretended to be responsible for education and 'forming' of the political leaders.[50] Where universities had themselves emphasized their capacities to prepare students to become strong and civilized leaders, these leaders now turned out to be powerless. Therefore, it is likely that trust in universities and thus science in general was declining in the 1930s, following a general decline of trust in authority.

Scientists, being part of the 'intellectual sphere', reacted to these problems. Their thoughts on their own role in society shifted during the first three decades of the twentieth century. This was of course partly a reaction to social changes in the Netherlands. After the Pacificatie and the introduction of universal suffrage, 'public opinion' on science was in the early 1900s more important than it had ever been before. This importance is of course another reason why studying the public reception of relativity is very interesting. It is however also important at this point to realize that 'the scientist as professional researcher' was still quite a new phenomenon at Dutch universities. In the first half of the nineteenth century, there was no clear demarcation between scientists and laymen: both were members of the same cultural and scientific societies and 'knowledge' was to be shared among the members of these societies.[51] Scientists only became professional researchers during the later part of the nineteenth century, when state support for universities increased. Instead of through direct contact with their audience, scientists were now only related with society via the authorities, 'the guardians of public interest'.[52] Towards the turn of the century, the legitimization of science became based on the idea that research was in the interest of society. Around 1900, scientists in general argued that society would indeed benefit from scientific research, but would do so especially when scientists were free to pursue 'pure science'. Social benefits would come naturally from their research, but those benefits were not to be the primary aim of science.[53] This attitude of course

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[48] Baneke, *Synthetisch Denken*, pp. 42-45.
[49] De Jonge, *Crisis en critiek*. The 'small crisis' is contrasted to the 'large crisis' of the 1930s, which consisted of reactionary, right-wing and anti-democratic sentiments. See especially pp. 6-8 and 17-19.
[50] Baneke, *Synthetisch Denken*, p. 54.
[51] See Mijnhardt "De Akademie", especially pp. 17-24. Mijnhardt discusses the development of the 'cultural ideal' in the Netherlands in the nineteenth century. He argues that there is an evolution from an egalitarian ideal in the first half of the nineteenth century, to a situation in which individuality and professional elites were celebrated in the later part of the century.
[52] *Ibid*., p. 32.
[53] Theunissen, "Zuivere wetenschap", p. 142.

further emphasized the difference between professional scientists and the public, with the latter's role changing from critical receiver to mere audience.

The ideal of pure science and the growing distance between scientists and the public created the metaphor of the 'ivory tower of science'. Scientists would supposedly perform their research in seclusion, independent from the reality of society. A number of reasons, which will be discussed more fully in the next section, caused scientists in the period right after the First World War to call for a descent from their ivory towers. During the Interbellum academics did try to remain in contact with society: science was popularized "as it had never been before",[54] and scientists presented themselves as 'experts', willing to advise government or industry. In that role, scientists could both enhance their status and secure opportunities in the job market for their students. In contrast to the pre-war emphasis on pure science, during the 1920s scientists became keen to cooperate with industrial and agricultural sectors, and focus their research more and more on applied science and social problems.[55]

Although it seems likely that this new ideal of 'applied scientific research' acquired wide support, most studies on the 'role of science' in the interwar period have as yet focused on rhetoric of scientists actually carrying out this research. As relativity seems to embody research without any apparent applications whatsoever, its reception in the Netherlands could shed light on public support for applied science versus public appreciation of ivory-tower-science. The public reception of relativity took place just before the transition from the modernist turn-of-the-century attitudes to the pessimistic public stance towards authority and anti-intellectual sentiments after the crisis of 1929. Therefore, it could be very helpful in understanding this particular transformation in public opinion.

Professionalization of science

Thus, in the Netherlands, the origins of 'modern science' lie in the mid-nineteenth century. In the egalitarian Dutch society of the eighteenth and early nineteenth century, private academies and scientific societies played a relatively minor role compared to other countries.[56] Universities were mainly oriented towards education until the mid-nineteenth century, when ideals of 'pure science' and autonomous universities started to gain influence in the Netherlands, replacing the egalitarian spirit of Dutch society with an ideal of professional science.[57] The emphasis on research was formalized by the 'Law on Higher Education' of 1876.[58] The period between 1876 and the First World War was one of the most fruitful Dutch science ever experienced, and has become known as the 'second golden age' of Dutch science. In this golden age 'research' became the new key word, and under influence of the modernist spirit Dutch scientists strove for social progress and utilizable scientific research.

While the usefulness of science had thus been emphasized by scientists before, scientific research became focused directly on the problems of society only from about 1900 on. Scientists felt that an outward stance – the scientist in society – was in the interest of both their own enterprise and that of society. Industrialization had just taken place in the Netherlands, and had led to a rapid increase in the use of technology. On top of that the population had been growing

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[54] Van Berkel, "Oude en nieuwe universiteit", p. 185.
[55] This is widely discussed in studies on the history of Dutch science in the interwar period, see e.g. Theunissen, "Zuivere wetenschap"; Van Lunteren, *Uit de ivoren toren*.
[56] Van Berkel, "Over nationale stijl", pp. 18-19.
[57] For a discussion of the transformation of Dutch science in the nineteenth century, see e.g. Mijnhardt, "De Akademie"; Maas, "Civil Scientists".
[58] Dorsman, "Onderzoek in opdracht"; Maas, *Atomisme*.

from three million in 1850 to five million in 1900.[59] Dutch authorities founded several commissions and institutes to guarantee the quality of domestic industrial products, also in order to promote its own industry.[60] Around 1900, this led to the creation of public research laboratories in the Netherlands.[61] Although the universities were at first not directly related to industrial research, academics started to become engaged with social problems. They were motivated by the idea that science could be much more helpful to society when research would be applied directly to problems of society. Relations between science and industry were very much in the interest of the universities too, as the number of graduates was ever increasing, and professors needed to create job perspectives in order to keep students interested in their disciplines.[62]

This of course had to do with institutional changes at the universities as well. Where in the late nineteenth century, the main career perspective for students in the exact sciences had been a position as high school teacher, around the turn of the century the demand for academically trained personnel in trade and industry increased. At the same time, the number of institutes of higher education grew rapidly. Since 1877, there had been four acknowledged universities in the Netherlands; in 1905, the Reformed Free University additionally obtained the status of full university, while the polytechnic institute in Delft achieved the level of academy college of applied science. The agricultural college in Wageningen followed 'Delft' in 1917, and the Catholic university of Nijmegen was founded in 1923. Student numbers in the sciences were on the rise as well, a process boosted by the Limburg-law of 1917. This law opened up the universities for graduates of the *HBS*, a type of secondary education which put more emphasis on a preparation for a study in natural science than the *gymnasium*, the traditional lead-up to academic education.

Funding and career prospects increasingly became subject to competition between institutes of higher education. This forced the universities even more to prepare their students for life in business, rather than to focus on what was called 'general formation' (related to German *Bildung*).[63] 'Academic' or general 'formation' was, just like 'applied science', a key notion in debates on education in the first decades of the twentieth century. Although universities traditionally had paid much attention to the 'formation' of cultured and civilized thinkers, society now supposedly demanded decisiveness. Universities had to train strong and competent leaders that would deal with the problems created by the Great War, not a type of scholars that would be occupy itself with esoteric problems. This raises questions about how to legitimatize any work on relativity. Did physicists find a way to present relativity as understandable and related to practical matters, or did they have way to show the usefulness of research in theoretical physics? I will come back to this in a moment.

Anyway, developments similar to those in the Netherlands took place over the whole of the Western World due to the First World War, and the relations between science and society took an important turn between 1914 and 1918. Britain and France had been reforming and linking together their industries and academic research in the years before the war, "as fears of German efficiency increased".[64] Before the industrialization of research, science in Britain and France had also been characterized with the exact same metaphor of the ivory tower as it was in

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[59] Huijnen, "Universiteit en bedrijfsleven", p. 24.
[60] See Faber, "Van Nieuwenburg", p. 24; Huijnen, "Universiteit en bedrijfsleven", p. 34.
[61] See Van Rooij, "Modellen van Onderzoek", pp. 141-142.
[62] Van Lunteren, *Uit de ivoren toren*, p. 6.
[63] Dorsman, "Onderzoek in opdracht"; Baneke, *Synthetisch Denken*, in particular pp. 49-50.
[64] MacLeod & MacLeod, "Social Relations of Science", p. 304.

Holland,[65] but the "exigencies of war" lead to an enormous increase in the organization of applied science that aimed at national interest.[66] In the United States, science had already focused on practical research before World War I. After the war, the Americans tried to stimulate applied science in former Allied countries, by calling for the creation of national councils for applied research based on the American example. These councils were to stimulate both applied and fundamental science, as well as scientific research in the area of national defence.[67]

Although the First World War had much less impact on Dutch science and industry than it had in the belligerent countries, trade barriers did cause a shortage of agricultural products and raw materials in the Netherland. This lead to an increased interest in domestic industry.[68] Where before the war a large share of these products was imported from Germany, this was no longer possible during and right after the war. Adaptations in science policies made right after the war in belligerent countries were echoed by Dutch authorities, although measures taken were much less drastic. Where in for instance Britain numerous research institutes and councils were created to promote applied science, the Netherlands at first only created a commission which was to promote 'research relevant for society'. This establishment of this commission, which was created in 1918 and headed by none-other than Hendrik Lorentz, is generally considered the first step in the creation of the *Dutch Organisation for Applied Scientific Research* (TNO). This organization was created to carry out research in applied science; to promote the application of knowledge; and to manage the relations between science and industry. But although TNO was officially founded in 1932, it only gained actual influence after the Second World War.[69]

Nevertheless, the Dutch did pay more attention to the applications of science, thus participating in an international process. Scientists would after the First World War in general approve of the idea that scientific research would have to be connected with society, which was, as we have seen, certainly also in their own interest. The actual proponents of applied academic research and connections between universities and industry existed however of a small group of professors.[70] Among this group were nevertheless many of the leading scientists in the Netherlands. These were in general the same people involved in the other great social project of Dutch interwar science: the reestablishment of scientific relations between the former warring countries,[71] which, as we will see, played an important role in the reception of relativity in the Netherlands. Apart from Lorentz, the most prominent scientists engaged with the problems of science and its utility were the biologist F.A.F.C. Went and the chemist H.R. Kruyt.[72] Went and Kruyt were major figures in Dutch science. Both were members of the 1918 commission headed Lorentz; they would both become director of TNO; and both were emissaries of the Dutch movement for interwar scientific reconciliation.[73]

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[65] *Ibid*., p. 312 and p. 324.
[66] *Ibid*., pp. 307-318.
[67] Kevles, "Into Hostile Camps".
[68] Huijnen, "Universiteit en bedrijfsleven", pp. 24-25.
[69] See for instance Van Rooij, "Modellen van Onderzoek"; Faber "Van Nieuwenburg"; Somsen, "Hooge School".
[70] Hollestelle, in "Zuivere praktijk", states that only around twenty professors were actually in contact with major companies in the interwar period, see p. 56. Baneke claims that the majority of scientists in the first half of the twentieth century wanted to be 'left alone', see "Toegepaste natuurwetenschap", p. 34.
[71] Otterspeer & Schuller tot Peursum-Meijer *Wetenschap en wereldvrede*.
[72] The points of view taken by both Kruyt and Went are both already extensively discussed, see for instance Somsen, "Hooge School"; Baneke, "Toegepaste natuurwetenschap"; Van Lunteren, *Uit de ivoren toren*.
[73] Otterspeer & Schuller tot Peursum-Meijer, *Wetenschap en wereldvrede*, pp. 157-159.

The turn to applied science and practical problems was by contemporaries considered part of a process of Americanization. Scientists felt that the pre-war focus on German culture now shifted to a focus on the United States.[74] Several prominent Dutch scientists visited the United States, including the aforementioned Lorentz, Kruyt and Went, but also physicists like Ehrenfest and Philip Kohnstamm.[75] The focus on practical problems and collaboration with industry led to a further professionalization of science, and in the aftermath of the war, Dutch scientists, along with other "entered a world in which professional goals, the pursuit of knowledge and the demands of economic interest were to fitfully co-exist."[76] This was exactly what for instance Kruyt envisioned, but the majority of Dutch scientists would argue that although applied science was important, it did not belong at the universities.[77] Most scientists were content with their status as professional researcher, and did not want to take part in what could be considered further professionalization. They did not want to actually work on direct applications, and were not prone to raise additional funds for research. Instead of producing results industry could work with, many scientists stuck with the ideal of ivory tower science. Nevertheless, we see that there certainly was pressure from within science to strengthen connections with the 'outside world', and that changes on both institutional level and in the role of social engagement of science could not be disregarded.

A physicist perspective on the role of science

In order to relate these changes in the role of science to the popular reception of relativity theory, we now need to focus on the role played by physicists in the professionalization of science and scientific research. To which extent did they adapt their rhetoric to the upcoming interest in applications of science, and, more importantly, did their research shift to applied science? If so, what impact did that have on their 'pure research'? These questions need to be addressed before we turn to the reception of relativity, as they will help in understanding how, and for what reasons, Dutch physicists tried to legitimize their work on relativity theory.

Physics became one of the most important disciplines in Dutch science around the turn of the century. In the course of the nineteenth century, the natural sciences in general had caught up with medicine, which had been by far the most important science in the early part of the century. In the 1870s and 1880s, prominent work of theoretical physicists such as Lorentz and Van der Waals had given physics much prestige, and at the turn of the century, the administration of the science department of the authoritative Royal Academy of Sciences was formed by Van der Waals and the astronomer H.G. van de Sande Bakhuyzen, who was succeeded by Lorentz himself in 1910. Lorentz was a preeminent figure in Dutch science. Besides his role in the Academy, Lorentz chaired many international scientific congresses and, as discussed, led the state commission on applied research established in 1918. Although physicists clearly played an important role in turn-of-the-century Dutch science, they were at that time rather reluctant to support applied science and industry. The spirit of pure science, and the idea that fundamental research would eventually lead to most benefit for society was probably retained longer among physicists than among scientists in general.

The prime example of a supporter of ivory-tower-science in the period before the First World War was of course Lorentz himself. Even in March 1918, when Lorentz had already been appointed as chairman of his committee on applied science, he stated in a public address that his

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[74] *Ibid*., pp. 212-213.
[75] Hollestelle, "Zuivere praktijk", p. 63.
[76] MacLeod & MacLeod, "Social Relations of Science", p. 320.
[77] Baneke, "Toegepaste natuurwetenschap", p. 35.

previous pursuits in applied science were negligible.[78] Interesting in Lorentz' case is that he in fact became very much involved with applied science from July 1918 onwards, when he was appointed as head of another state commission which was concerned with the closure of the Zuiderzee and the consequences this closure would have for flood protection.[79] Nonetheless, Lorentz had scarce connections with applied science before the war, which was also the case for his fellow physicists Van der Waals and Kamerlingh Onnes. These three scientists together embodied the flourishing period of physics around the turn of the century. They were all Nobel Prize winners, and all three had concentrated on fundamental research. In the case of Van der Waals, the newspaper the *Nieuws van den Dag* argued in 1908 that his research on gaseous and liquid states was not in any way useful for the public, but that this was not at all a problem, since this kind of fundamental science was, in contrast to for instance chemistry, not supposed to be applicable: it was supposed to further the knowledge of nature.[80] Kamerlingh Onnes was of the same opinion, as he himself stated that his work on extremely low temperatures was not in any way utilizable.[81] It has been argued that before the First World War, physics was "cultivated as an art",[82] rather than as a professional enterprise.

But, in the physics community too, the war was a turning point. Under influence of American examples, several Dutch physicists started working together with industry and private research laboratories. Besides the necessity to cope with industrialization and social problems, this was certainly also a reaction to the competition of the academy of applied science in Delft.[83] The competition between university physicists and the engineers of 'Delft' became tangible around the mid 1920s. At that point, both the universities of Amsterdam and Utrecht maintained laboratories where applied research was carried out in experimental physics. In contrast to Kamerlingh Onnes' earlier laboratory work in Leiden, A.M.J.F. Michels in Amsterdam and L.S. Ornstein in Utrecht actually performed research in collaboration with industry.[84] Where Michels was still arguing that his research was fundamental, Ornstein was a proponent of applied science and held close relations with industry. This general focus on applied research was reflected in the call for and actual appointment of 'special' professors in applied research at the universities of Leiden, Utrecht and Amsterdam. In Leiden, Ehrenfest furthermore established relations with the research institute of electronics giant Philips, and tried to invoke applied science in his theoretical projects by both pleading for a chair in applied science and arranging internships for his students in Ornstein's laboratory.[85]

Although they were clearly involved with applied science, Ornstein, Ehrenfest and Michels all kept emphasizing the primacy of fundamental research.[86] Ornstein would for

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[78] Lorentz, "Rede bij de aanvaarding van het doctoraat in de technische wetenschappen, honoris causa, 7 maart 1918", *De Ingenieur*, 33, 1918, pp. 318-325, on p. 323. Cited in Theunissen & Klomp, "Lorentz", p. 5. This address was held in March 1918; the commission headed by Lorentz was officially established in February 1918.

[79] On Lorentz' work on the Zuiderzee commission, see Kox, "Uit de hand gelopen onderzoek".

[80] *Het Nieuws van den Dag*, April 2, 1908, p. 1, "Twee Hollandsche geleerden". Part of this article is cited in Rip & Boeker, "Scientists and Social Responsibility", p. 458.

[81] See Baneke, "Toegepaste natuurwetenschap", p. 30. Although Kamerlingh Onnes was on good terms with his colleagues at the research laboratory of Philips and with his instrument-makers, he did not actually perform any research for them. Kamerlingh Onnes strictly opposed any deviations from his research programme on cryogenics. See Van Delft, *Freezing physics*, in particular pp. 590-599.

[82] Rip & Boeker, "Scientists and Social Responsibility", p. 459.

[83] Huijnen, "Universiteit en bedrijfsleven", p. 28.

[84] *Ibid*., pp. 30-31; Hollestelle, "Zuivere praktijk", pp. 59-60. For Michels, see also Maas, *Atomisme*, pp. 185-189; for Ornstein, see Heijmans, "Wetenschap en industrie".

[85] Hollestelle, "Zuivere praktijk".

[86] *Ibid*., p. 65.

instance continuously argue that his work on applied science still owed very much to fundamental research. Ornstein considered himself and his students to be 'real' scientists, not to be confused with mere technicians. His students would truly 'apply' science and scientific methods to their research.[87] Nevertheless, experimental physics had after the First World War become much more professional in the sense that – in many cases – academics were working together with industry and were aiming directly at applicable results. The question arises whether there was any difference in this sense between theoretical and experimental physics. These disciplines were not yet strictly separated, as can be concluded from the fact that the theorist Ehrenfest did not hesitate to send his students to the laboratory. Other theoretical physicist such as Van der Waals jr. however did not enter the debate on applied science, and historian of science Baneke has argued that astronomers, who were very close to theoretical physicists, did not have to answer to demands of utility, and were still proudly arguing that their research was not applicable to society in any way during the interwar period.[88] Research on the theory of relativity was exactly located on the boundary between astronomy and physics, and is therefore an excellent test case for Baneke's statement.

[87] Heijmans, "Wetenschap en industrie", especially p. 185.
[88] Baneke, "Toegepaste natuurwetenschap", p. 32.

3. The scientific reception of relativity theory

The history of Einstein's relativity theory begins in 1905, when Einstein published his *Zur Elektrodynamik* in the *Annalen der Physik*.[89] At that time, Einstein had not yet secured an academic position: he was employed in a patent office in Bern. Nonetheless, his work started to arouse interest in the German scientific community rather quickly, as the group around Max Planck, Germany's champion of theoretical physics, became interested in Einstein's work. This interest was not only triggered by his work on relativity; in the same year as his *Zur Elektrodynamik*, Einstein also published important articles on molecular theory, Brownian motion and light-quanta. Einstein's 'relativity principle' was, also by Einstein himself, considered an elaboration of existing theories on electrodynamics of moving bodies. His work on light-quanta on the other hand proposed a new point of view on the nature of light. Not relativity, but these light-quanta were initially considered as Einstein's most revolutionary contribution to physics. In Germany, Einstein's work on relativity was in general recognized as such only after it had been worked out by the mathematician Hermann Minkoswki, who clearly showed that relativity presented a new understanding of space and time. In 1911, a significant part of the German scientific community had been convinced of the merits of Einstein's point of view. After Einstein developed his general theory of relativity between 1913 and 1915, his 1905 article on relativity became known as the 'special theory of relativity', and is now considered a milestone in the development of modern physics.[90]

This chapter has a twofold aim. First, I hope to give a concise introduction to the interpretation, innovative aspects and the development of relativity theory itself. Of course, this will mainly be concentrated on the Dutch contributions, as the overarching goal here is to understand the position and significance of relativity theory in Dutch science. I will not go into too much detail on the technicalities of the research; interested readers are referred to the bibliography. Where details are a necessity, I will try to describe them as accessible as possible for any non-specialist. Besides introducing the theory of relativity, another aim here is to become acquainted with the main protagonists of Einstein's work in the Netherlands. In the first chapter, I have argued that although the scientific and public receptions have to be separated, the connection between the two cannot be characterized by simple transmission and dissemination. Nonetheless, many views on relativity prevalent among Dutch scientists would be adapted, echoed, and employed in public reactions: physicists of course were the main source of information for their lay public. Understanding the relations Dutch physicists had with relativity theory is vital if one wishes to study their popularization of the theory, which in turn is vital for a clear appreciation of their influence on the public reception of relativity. By an analysis of scientists' 'scientific' positions on Einstein's work, it will be easier to put their pursuits in popularizing relativity into context.

Although Einstein published his first article on relativity as early as 1905, his work was first discussed in print in the Netherlands only in 1909. Johannes Diderik van der Waals junior, son of the Nobel Prize laureate of the same name mentioned in the previous chapter, examined

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[89] Einstein, "Zur Elektrodynamik". In this article, Einstein discussed the electrodynamics of moving bodies and posed the two postulates that later came to define 'the special theory of relativity'.

[90] After 1915, Einstein's general relativity became an established theory, and Einstein himself had become a prominent scientist in German theoretical physics in 1914 when he obtained an important position in Berlin. Much of his work would however be disputed for years. Even in 1922, when Einstein was awarded the Nobel Prize, his theory of relativity was deemed too controversial. Einstein was instead rewarded for his work on the photoelectric effect, which was a small part of his work on light-quanta. The quanta in turn were themselves also still heavily criticized, and could thus not warrant Einstein's Nobel Prize either.

what he felt were 'the most fundamental ideas' in physics in his inaugural lecture at the University of Amsterdam. According to Van der Waals jr., there were three possible 'worldviews' in physics: the mechanical view of nature, which tried to describe everything in terms of moving matter; the electromagnetic worldview, wherein electromagnetic effects induced by charged particles (electrons) were the most fundamental entities; and Einstein's idea of relativity, which was close to the electromagnetic view as it was also dealing mainly with electrodynamics. According to Van der Waals however, Einstein denied the existence of some of the main constituents of the electromagnetic worldview, and proposed a new conception of simultaneity. Van der Waals made clear that although Einstein's theory might seem promising at first, he himself did not agree with these new ideas. In order to make sense of Einstein's work, either a paradoxical notion of time had to be accepted, or relativity had to be interpreted from the electromagnetic point of view, in which case it did not add anything new to already existing work.[91] Van der Waals' dismissive reaction to relativity seems quite remarkable, but was in fact firmly rooted in the leading research programme of Dutch theoretical physics around 1900.

Dutch electrodynamics before relativity

Turn-of-the-century Dutch electrodynamics was dominated by Hendrik Lorentz' electron theory, which was largely devised between 1892 and 1904. In that same period, Lorentz had become one of the world's leading theoretical physicist, and held high prestige in both the Netherlands and its surrounding countries. Based on two fundamental entities, the 'luminiferous ether' and charged particles – which Lorentz would identify as 'electrons' following J.J. Thompson's cathode rays experiments of 1897 and Pieter Zeeman's investigations of magnetic influences on the splitting of spectral lines in 1896 – the electron theory could solve many issues that had troubled work in optics and electrodynamics in the later half of the nineteenth century. The main result of Lorentz' work was the extension of James Maxwell's electromagnetic theory, which was only valid for systems with charges in rest with respect to each other, to dynamical systems. With some well-chosen transformations and adaptations, Lorentz had been able to show that the laws of nature were independent of the velocity of the measuring system; by that, he had also been able to explain the famous and seemingly paradoxical null-result of the 1887 Michelson-Morley experiment.[92]

The Michelson-Morley result was the climax of nineteenth century interference experiments, which had been performed to investigate the nature of light. Throughout the 1800s, scientists had maintained that light-rays existed of waves, not particles. Light-waves however had to be sustained by some medium: the luminiferous (light-bearing) ether. Interference experiments had been used many times during the century to test rivalling theories on the supposed ether. In course of the century however, it turned out that the two most important conceptions of the ether, those of Augustin-Jean Fresnel and George Stokes, were in contradiction with empirical results, and could not be brought into consistency with those results. Both these ethers predicted the existence of measurable mechanical effects which did not occur: Fresnel's ether in optical phenomena such as refraction and dispersion, the Stokes ether contradicted the important Fizeau-experiment of 1851 and could not explain stellar aberration.

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[91] Van der Waals jr., *Meest fundamenteele wetten*, in particular pp. 28-38.
[92] Lorentz' electron theory is discussed in detail in Hirosige, "Origins", McCormmach, "H.A. Lorentz", and Nersessian, "Why wasn't Lorentz Einstein?".

After Maxwell's identification of light as electromagnetic radiation in the 1860s, concepts of the ether became even more sophisticated. The ether was no longer considered the carrier of light alone; it became the seat of all electromagnetic waves, which complicated its conception even further. Lorentz' work formed a breakthrough in this area: by supposing that the ether was not affected by any mechanical forces at all, Lorentz was able to circumvent its main problems. He brought his theory in agreement with up-to-date experimental evidence and extended Maxwell's theory to a generalized electro*dynamics*.[93] Thereby, Lorentz dealt the final blow the mechanical worldview, and replaced moving particles by electromagnetic fields as the most fundamental entities in physical nature.

The success of Lorentz' electron theory is best illustrated by the fact that around 1900, many attempts were made to apply the electron theory to other fields of physics. Persistent efforts were made to incorporate especially the phenomena of radiation and gravitation into the new electrodynamics. Adherents of the 'electromagnetic worldview' considered Lorentz' theory the most fundamental work in physics, and tried to explain all natural phenomena in terms of its basic constituents, electrons and the ether,[94] in the hope to unify all physical phenomena into one 'monistic' theory. One main problem however remained. Although Lorentz had succeeded in bringing the ether in correspondence with empirical evidence, the new ether now seemed to be no longer detectable by any experiment. Furthermore, as it had become the seat of the electromagnetic field, the frame in which the ether was at rest was considered the preferred frame of reference in electrodynamics. This meant that some effects in frames moving with respect to the ether were considered as fictitious.

Einstein derived in his 1905 paper on special relativity the exact same set of equations as Lorentz had presented in his electron theory, including what had by then become known as the 'Lorentz transformations'. Einstein however did not have to assume the existence of the ether. Einstein obtained his formalism by using kinematics only. In order to arrive at the correct equations, Einstein postulated that the laws of physics would be equivalent in all non-accelerated frames of reference, and further assumed a constant velocity of light. Combining these two postulates made a radical reformulation of the concept of simultaneity unavoidable for Einstein. Both the constancy of the speed of light and 'principle of relativity' also featured in the electron theory, and the theories of Lorentz and Einstein actually were empirically equivalent. Lorentz, however, considered the reassessment of the concept of simultaneity a mathematical trick instead of a fundamental change in the concept of time. Only in the preferred frame of reference did the coordinate t stand for a real time; in other frames of reference, where t would take on other values due to the Lorentz transformations, t was only a mathematical auxiliary quantity without fundamental significance. Einstein on the other hand denied the existence of a preferred frame of reference, which meant that t was the true time in all frames. The ultimate consequence of this interpretation was that time would run at different speeds in different frames of reference. This meant that the concept of 'simultaneity' lost its absolute character.[95]

As a consequence of the empirical equivalence of Lorentz' electron theory and Einstein's relativity, Einstein's initial work was generally considered as an expansion of Lorentz theory,

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[93] On the development of the ether in the nineteenth century, see Hirosige, "The Ether Problem" and Janssen & Stachel, "Optics and Electrodynamics".

[94] For a discussion of Lorentz' electron theory and its influence on the electromagnetic worldview, see McCormmach, "H. A. Lorentz".

[95] For a concise discussion of the interpretational differences between Lorentz' electron theory and Einstein's special relativity, see e.g. Janssen, "Reconsidering".

also by Einstein himself.[96] The interpretational differences were not always made explicit, and the relation between the theories of Lorentz and Einstein was strengthened by the fact that rival theories in electrodynamics actually did make different empirical predictions than the 'Lorentz-Einstein' theory. The most important of these rivals were proposed by Walter Kaufmann, Alfred Bucherer and Max Abraham. These three German physicists all developed a rival electron theory that explained some of the crucial aspects of the electrodynamics of moving bodies slightly different than Lorentz had done. Where Lorentz' electrons for instance contracted slightly in the direction of motion, Abraham's electrons were absolutely rigid, which enabled Abraham to explain the stability of electrons in terms of electromagnetic forces only.

The early reception of relativity in the Netherlands, 1905-1912

Van der Waals jr. was one of the scientists that did not consider the differences between the theories of Lorentz and Einstein to be fundamental. Therefore, he saw no need to seriously consider Einstein's work. In 1912, he argued that empirical evidence for 'relativity' was lacking in general, as at that point yet another theory, the light-emission theory of Walther Ritz which considered light-rays no longer as waves and did therefore not have to use any ether-concept, could explain the same crucial experimental results as Lorentz' ether theory. With the term 'relativity', Van der Waals here referred explicitly to the works of both Lorentz and Einstein, as 'relativity' for him only indicated the use of the Lorentz-transformations. That Einstein's version of that theory still only seemed paradoxical to him, was almost literally stated in a footnote: "Only these two theories [those of Lorentz en Ritz] seem to me to be in contention. Reasons to assume that the ether does not exist, but that the speeds of light would nonetheless be constant with respect to every observer, do not seem to exist; there certainly are no experimental reasons for that."[97] This was of course exactly Einstein's interpretation: 'special relativity' used a speed of light which was constant in every aspect, but had still abolished the ether as the preferred frame of reference. Although Van der Waals thus argued fiercely that Einstein's interpretation did not make sense, he had to admit that "this assumption is probably the most widely prevailing".[98]

So, there were clear reasons for Van der Waals jr. to argue strongly against relativity, as it was about to dominate his field of electrodynamics. As we go back to Van der Waals' inaugural lecture of 1909 and his threefold distinction in physical worldviews, we can now see that his preferred worldview, the electromagnetic one, was tightly connected with Dutch physics and Lorentz' work in particular. In the opening of his lecture, Van der Waals stressed the importance of the interpretation of physical phenomena. According to Van der Waals, many scientists would argue that they were dealing with facts only, and were not interested in 'pictures' of their theories. Van der Waals himself was of a different opinion: he considered these 'interpretations of theories' very important as only those pictures could point science in the direction of further research. Van der Waals was mainly interested in Einstein's relativity because of Einstein's claim in his 1905 article that he would remove an asymmetry in Maxwell's treatment of electrodynamics. If that had been true, relativity would have led to some progress towards the 'most fundamental laws of nature'. From Van der Waals' vantage point, however, Einstein's new

[96] Staley, "Histories of Relativity", pp. 272-277; See also Pyenson, "Relativity Revolution".
[97] Van der Waals jr. "Energiestroming", in particular pp. 961-962. "Slechts deze twee theorieën komen mij voor in aanmerking te komen. Eenige grond om aan te nemen, eensdeels dat de aether niet bestaat, en anderdeels dat de snelheid van het licht toch steeds *c* is ten opzichte van iedereen waarnemer, komt mij voorn niet te bestaan; een experimenteele grond is er zeker niet."
[98] *Ibid*.

concept of simultaneity was rather counterintuitive, while the electromagnetic worldview had lead to great progress in the years before, and was still a very promising metaphysical ideal.[99]

Van der Waals clearly showed interest in the foundations of physics. Already in his student years, he had been influenced by the neo-Kantian philosopher Cornelis Bellaar Spruyt; Kantian philosophy would continue to play a significant role in his physics.[100] Unsurprisingly, the ether was one of the main constituents of Van der Waals' preferred metaphysics. Furthermore, he strongly resisted any attacks on the concept of absolute time. Where Einstein had abandoned the ether as preferred frame of reference, Van der Waals, and with him many other scientists working in electrodynamics, argued that the ether was still necessary as the seat of electromagnetic waves, as those could not exist in mere empty space. Van der Waals' judgement on Einstein's notion of time and simultaneity was, as discussed at the beginning of this chapter, not very favourable either. Another argument connected with Van der Waals' interest in foundational issues, was his disappointment with the fact that Einstein postulated the equivalence of only non-accelerated frames of reference. According to Van der Waals, the principle of relativity would only make sense when it would hold for all possible frames.[101]

The emphasis on the philosophical side of their field was typical for the new generation of Dutch physicists that rose to prominence during the first decades of the twentieth century. Where the generation of Lorentz and Kamerlingh Onnes had generally abstained from philosophical conclusions, the younger physicists, including Van der Waals jr., Fokker and Kohnstamm, were in general very much interested in both philosophical and foundational issues.[102] In that sense, Van der Waals was typical for his generation. Ad Maas has described him as a typical exponent of Dutch science in yet another sense. Maas has argued that Van der Waals jr.'s work combined concepts pioneered by the two great theoreticians of the older generation, Van der Waals sr. and Hendrik Lorentz. Junior's work on the electromagnetic worldview and the corresponding 'electric monism', however, became increasingly backdated during the 1910s and 20s. According to Maas, Van der Waals did not pay much attention to the new physics, as he simply "did not have the drive" to carry out the kind of science that occupied other theoretical physicists.[103]

Nevertheless, Van der Waals jr. thus rejected Einstein's relativity on metaphysical grounds. Also in this respect, he could exemplify the typical Dutch scientist. As Einstein's work did not seem to differ significantly from Lorentz' theory, Einstein was initially neglected in the Netherlands, where, as A.J. Kox has asserted, "Lorentz was revered almost as a demigod".[104] Lorentz himself discussed Einstein's interpretation of relativity theory possibly as early as 1906, in a series of lectures at Columbia University. In the 1909 publication of these lectures, the following much quoted passage is found: "Einstein simply postulates what we have deduced, with some difficulty and not altogether satisfactorily, from the fundamental equations of the electromagnetic field. By doing so, he may certainly take credit for […] the manifestation of a general and fundamental principle. Yet, I think, something may also be claimed in favour of the form in which I have presented the theory. I cannot but regard the ether, which can be the seat

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[99] Van der Waals jr., *Meest fundamenteele wetten*. The third option, the mechanical view of nature was on the other hand definitely dismissed by turn-of-the-century physics according to Van der Waals, as it had not able to deal with all kinds the combination of the new radiation phenomena and electrodynamics.
[100] Maas, *Atomisme*, p. 100.
[101] Van der Waals jr., *Meest fundamenteele wetten*.
[102] See e.g. De Jong & Van Lunteren, "Fokkers Greep", Baneke, *Synthetisch Denken*.
[103] Maas, *Atomisme*, pp. 150-155.
[104] Kox, "General Relativity", p. 46.

of an electromagnetic field with its energy and its vibrations, as endowed with a certain degree of substantiality, however different it may be from all ordinary matter."[105]

Further comments made in 1910 provide the same picture. Lorentz recognized the epistemological differences between his own work and 'relativity', which he attributed to Einstein and Minkowski. At the same time, Lorentz affirmed that he preferred to hold on to his own interpretation, *with* an ether and absolute time. As Richard Staley notes, Lorentz made a clear distinction between the different interpretations, but was nevertheless "very happy to assimilate the continuing work" in the field of relativity.[106] Lorentz was very much interested in further development of 'relativistic physics' (here again including his own work); epistemological matters simply were not his main concern. This is illustrated by his correspondence with Einstein. Although the two physicists started corresponding in 1909, they did not discuss the differences in their approaches to relativity before 1913. The main subjects of their early letters were radiation theory and gravitation instead.[107]

The fact that Lorentz downplayed epistemological differences is characteristic for his view on progress of science. Even though he himself strongly preferred certain approaches, Lorentz was always willing to give a fair evaluation of work taking another point of view.[108] In 1904, before Einstein published on relativity, Lorentz already argued that different theories might be successful at accounting for different phenomena, but that "even though such considerations should warn us against taking a certain opinion to be the best or most satisfactory, they should not prevent us from advancing as far as possible on the path that strikes us as the most promising. Science can only benefit, if everyone does that in his own manner".[109] Lorentz' stance on Einstein's relativity was therefore exactly in agreement with what he considered as the best way to achieve scientific progress.

Thus, Lorentz personally favoured his own work over Einstein's approach. Dutch physicists like Van der Waals jr. not very surprisingly followed him in preferring the 'electron theory' over 'relativity'. Besides Lorentz and Van der Waals, one other noteworthy Dutch scientist published on the 'theory of relativity' in the early years. In 1911, the astronomer Willem de Sitter, a colleague of Lorentz in Leiden, published an article on the consequences of "the principle of relativity on astronomy" which clearly showed awareness of Einstein work, but failed to mention Einstein even once.[110] Instead, De Sitter credited Lorentz, Minkowski and Poincaré for the elaboration of relativity. Although other explanations are possible,[111] it seems

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[105] Printed in 1909 in Lorentz, *Theory of Electrons*, see p. 230. As Lorentz writes in his preface that he has "not refrained from making numerous additions", the exact date of his first encounter with 'special relativity' is unsure. However, it seems likely that Lorentz seen Einstein's work by December 1906, when Sommerfeld remarked to Lorentz that "in the mean time, I have studied Einstein too", after which he made some general comments on the differences between Lorentz and Einstein. See Sommerfeld to Lorentz, December 12, 1906, in Kox, *Lorentz Correspondence*, p. 206.

[106] Staley, "Histories of Relativity", pp. 288-289.

[107] The correspondence between Lorentz and Einstein can be found in Kox, *Lorentz Correspondence*. For discussions of their early correspondence, see McCormmach, "Einstein, Lorentz" and Kox, "Einstein and Lorentz".

[108] McCormmach, "Lorentz, Hendrik Antoon", p. 490.

[109] Lorentz, *Ergebnisse*, p. 83; cited in Frisch, "Mechanisms", p. 669. Frisch provides an interesting analysis of the resemblances between the metaphysics of Lorentz and Einstein.

[110] De Sitter, "On the bearing". Röhle, in *Willem de Sitter*, remarks that De Sitter must have known about Einstein's work as Einstein was cited in some of the work De Sitter referred to, see p. 41.

[111] Warwick, *Masters*, for instance argues that De Sitter's paper is adapted to his audience of *British* astronomers, and that De Sitter possibly refrained from discussing Einstein's interpretation in order to 'diffuse any antipathy towards relativity', see p. 454. However, this seems unlikely, as De Sitter would publish again on relativity theory in Britain before it was fully accepted there, and *did* mention Einstein in those publications. See for instance De Sitter, "Some problems" (1913), p. 302.

likely that De Sitter saw no advantages in Einstein's work. De Sitter's main interest was in possible observational consequences of 'relativity',[112] especially gravitational effects, as that was his own field of expertise. Therefore, he could just as well use Minkowski's mathematical generalization of relativity in his calculations. Crediting Lorentz, his direct colleague and advisor,[113] would only be natural for De Sitter. Regardless, it seems evident that none of the Dutch scientists working in the field of relativity reacted positively to Einstein's work in the period before 1913, as they clearly considered it inferior to Lorentz' electron theory. At the same time, Einstein's work did become the leading interpretation of 'relativity' in Germany around 1911.[114] The superiority of the 'Einstein-Lorentz theory' over its rivals was empirically established by Bucherer in 1908. Examinations of the differences between the theories of Lorentz and Einstein by Minkoswki, Kaufmann, Planck and Einstein himself had convinced the German physical community of the benefits of Einstein's approach.[115]

The main difference in the reception of relativity between the Netherlands and Germany, besides the fact that Einstein was of course part of the German scientific community, was the fact that in the Netherlands, Lorentz' theory dominated electrodynamics. In the next chapters, we will see that this played an important role in the public responses to relativity, but it certainly also did in the scientific reception. Although Van der Waals junior for instance regularly discussed other works on 'electron' and 'relativity' theories, these had to live up to Lorentz' theory before they could be seriously considered. In Germany, there was no single theory on electrodynamics which had the same kind of status as Lorentz' work had in the Netherlands. In Britain and France though, the situation was similar to that in the Netherlands. Joseph Larmor and Henri Poincaré had both developed theories quite similar to, and actually compatible with Lorentz' electron theory, and both men were leading scientists in their respective communities. In British, Dutch and French physics, Einstein's work could not stand the comparison with the theories of the respective native champions. But in contrast to Britain and France,[116] the evaluation of Einstein's relativity by Dutch physicist would change drastically even before the First World War.

Ehrenfest's arrival and the Lorentz-Einstein collaboration

The first breakthrough in the Dutch reception of relativity came with the appointment of Paul Ehrenfest in Leiden. Ehrenfest succeeded Lorentz as professor of theoretical physics in December 1912. When Lorentz had resigned his chair, he initially had tried to get Einstein appointed as his successor, but Einstein refused the position and recommended Ehrenfest instead. Ehrenfest had been travelling throughout Europe to find an academic position for a couple of years, and had become one of Einstein's closest friends since they had met in Prague in

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[112] De Sitter here only considered what can be called 'special relativistic effects', where Lorentz theory and Einstein's 1905 work would predict equal results. At the same time, Einstein and other were already working on 'post-special-relativistic theories' of gravitation (Earman & Janssen, "Einstein's Explanation", pp. 134-135).

[113] De Sitter, "On the bearing", p. 389, notes: "I also owe much to conversations with and advice from my colleague Professor Lorentz."

[114] Pyenson, "Relativity Revolution" and Staley, "Histories of Relativity", both discuss the early inception of Einstein's relativity theory in Germany. Both authors argue that from 1911 on, Einstein's work became the standard interpretation of 'relativity theory' among Germany theoretical physicists.

[115] Staley, "Histories of Relativity".

[116] For the neglect of Einstein's theory in Britain and France, see respectively Warwick, *Masters*, p. 443, and Paty, "Scientific Reception", p. 136.

February 1912.[117] Ehrenfest had already written some papers commenting on Einstein's relativity theory, with his main contribution being his rigid disk paradox in 1909. In this paradox, Ehrenfest showed that a rotating disk would contract along its circumference during rotation. This would then lead to a decrease in the radius of the disk, while at the same time relativity theory predicted that a moving body would not contract in directions perpendicular to the movement. According to Ehrenfest's article, relativity theory thus predicted that the radius of a rotating disk would at the same time have to be smaller *and* exactly equal to its original radius. This was not yet foreseen by Einstein, and would play an important role when Einstein later considered deformation of spacetime in his general theory of relativity.[118]

Ehrenfest immediately started advocating the Einsteinian interpretation of relativity when he arrived in the Netherlands. As he had been pondering Einstein's theory of relativity since 1906, and had discussed the very interpretation of relativity in correspondence with Einstein himself multiple times before he took the position in Leiden,[119] Ehrenfest had a clear idea of the differences between the theories of Einstein and Lorentz. He unveiled these differences straightaway in his inaugural lecture. In that lecture, Ehrenfest spoke about the development of the "crisis of the light-ether hypothesis",[120] and presented Einstein's work as a possible solution for that crisis. According to Ehrenfest, the paradox of the ether needed to be solved, and one way to do this was to use 'relativity theory', a term which from now on was used in Leiden – as it will be from now on in this article – to denote Einstein's theory exclusively.[121]

Ehrenfest's inaugural lecture had a huge impact on its audience, not in the least because of the style in which Ehrenfest presented it. As Ehrenfest's biographer Klein puts it: "[The audience] had come to hear a professor lecture – they were caught up and captured by a man who taught as though his life depended on it. Over twenty years later some of them remembered the breathless suspense with which they had listened to his words."[122] It is clear that Ehrenfest had an enormous impact on the physics community in Leiden, its professors and students alike. Instead of developing interest in relativity theory by including it piecemeal in its own research programmes, Leiden had now directly appointed a professor already aware of the details of the theory. The appointment of Ehrenfest thus led to an immediate integration of relativity. In March 1913, only a couple of months after Ehrenfest's inaugural lecture, Lorentz held the first public address on relativity theory in the Netherlands.[123] In an article written in February 1913, De Sitter now referred to both Lorentz and Einstein to contrast relativity with the theory of Ritz, whose theory had also been discussed in Ehrenfest's lecture. Interestingly, in this two-page article,[124] De Sitter was able to settle the dispute in favour of Lorentz and Einstein, by demonstrating that Ritz' theory was in contradiction with measurements on the speed of light emitted by twin stars. Again, De Sitter did not go into interpretational issues, but focused on the empirical consequences of different theories.

Ehrenfest's entrance in Leiden was however not the sole reason for an increased interest in relativity theory in Holland. Einstein had attempted to incorporate gravitational effects into his theory since 1907, but in 1913, he published a quite elaborate attempt at a "draft of a generalized theory of relativity and gravitation", together with the mathematician Marcel

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[117] Klein, *Ehrenfest*, pp. 175-179.
[118] Stachel, "Rigidly rotating disk".
[119] Klein, *Ehrenfest*, pp. 150-156.
[120] Ehrenfest, "Zur Krise".
[121] Klein, *Ehrenfest*, pp. 1-5.
[122] *Ibid*., p. 5.
[123] Lorentz, *Relativiteitsbeginsel*.
[124] De Sitter, "Een bewijs".

Grossmann.[125] Lorentz was immediately interested in this 'Entwurf' theory; he himself had struggled to combine his electron theory and gravitation since 1900.[126] Mid 1913, Lorentz and Einstein corresponded on the new theory of gravity, and in 1914, Lorentz published an article on the field equations used by Einstein. Lorentz' 'sudden' interest in relativity can easily be explained: where the initial special theory of relativity had no clear empirical advantage over his own work, Einstein's gravitational work now in fact did promise new results. This however did not mean that Lorentz suddenly became convinced of Einstein's approach. In January 1915, Lorentz again made a case for the usefulness of the concept of 'absolute time', and argued that Einstein's Entwurf theory in fact admitted preferred frames of reference.[127] But while Lorentz still argued that the ether was a useful concept, Einstein was working frantically to exclude any preferred reference frames in his generalized theory of relativity, which he completed in November 1915.

Leiden physics after general relativity

Both Lorentz and Ehrenfest became close collaborators of Einstein in the early development of general relativity. Although Lorentz had resigned his position in Leiden, he still held one lecture at the university every week, and was in close contact with the physicists there. The interest from the Leiden group in the general theory of relativity persisted under the guidance of Ehrenfest and Lorentz, and when Einstein published his final theory in the winter of 1915-1916, Leiden physicists immediately set out to work on the theory. One of the main achievements of general relativity was its extension of the 'principle of relativity' from frames of reference in uniform motions to all possible frames, even accelerated and rotating ones. Furthermore, the general theory gave a new explanation of gravitation. This directly enabled Einstein to solve a long-standing problem in the motion of the planet Mercury. According to Einstein's general relativity, gravitation would 'curve' spacetime: what would be straight lines in a part of space devoid of matter, would become deformed in the presence of masses. The new theory also predicted that light-rays would be influenced by gravitation, and this was the new and spectacular prediction that was confirmed in a 'crucial experiment' by the British eclipse expedition of 1919.

Lorentz was "so much impressed by the beauty and the originality of the theory that he almost naturally became involved in its development, and became one if its first ardent propagandists in the Netherlands".[128] In the spring of 1916, Lorentz lectured on general relativity, "and trough these lectures and the accompanying discussions, a group of scientists […] obtained a working knowledge and a deep insight in the new theory".[129] Apart from Lorentz and Ehrenfest, the principal members of this group of scientists were, according to A.J. Kox: the students Johannes Droste, Adriaan Fokker, who had studied with Einstein in the winter of 1913-1914 and Hendrik Kramers; Gunnar Nordstrom, who worked in Leiden during the period 1916-1919 and had developed a theory of gravitation himself that he abandoned after becoming familiar with general relativity; the astronomer De Sitter; and the mathematician Jan Schouten. Schouten actually was not working in Leiden, but at the nearby academy at Delft. He however

[125] Einstein & Grossmann, "Entwurf".
[126] See e.g. Lorentz, "Considerations".
[127] Lorentz work on Einstein's relativity is discussed in Kox, "Lorentz, the Ether", and Illy, "Einstein Teaches Lorentz".
[128] Kox, "Lorentz, the Ether", p. 2.
[129] Kox, "General Relativity".

had a direct connection with the Leiden group, as in 1917, Dirk Jan Struik, former student of Ehrenfest en Lorentz, was appointed as Schouten's research assistant.

The Dutch work on general relativity has been discussed in detail by Kox, who concludes that the contribution from Leiden was of sizable contemporary importance. This was not only the case because of the importance of some of the publications, but also because of the respectability that arose from the prestigious group of physicists including Lorentz, Ehrenfest and De Sitter.[130] However, apart from De Sitter and Fokker (Fokker was mainly interested in the philosophical interpretations of Einstein's work and science popularization; I will discuss those in the next chapters), other members of this group soon lost interest in general relativity, and the amount of research on the theory declined rapidly around 1920.

Although Lorentz and Droste made some important contributions to general relativity, the main influence of the Dutch group lied in De Sitter's work. Between 1916 and 1918, De Sitter developed a solution of Einstein's field equations different from Einstein's own work, and De Sitter profoundly influenced the development of Einstein's own ideas on general relativity in the period 1916-1920.[131] Together with Fokker, De Sitter was also responsible for introducing general relativity in Britain, where it had not yet become known because of the First World War. Fokker published a summary of Einstein's earlier work on gravitation and relativity in 1915;[132] De Sitter discussed the final theory of relativity in 1916 and 1917 in a number of articles in Britain via his colleague Arthur Eddington.[133] In turn, Eddington became the foremost British expert on general relativity, and was one of the key figures in the 1919 crucial experiment on gravitational light-bending.

General relativity thus became one of the main research topics in Leiden physics. Close personal relations between Einstein, Lorentz and Ehrenfest were the main reason for the swift inception of research in general relativity in the Netherlands. The fact remains however that the general theory was also much more interesting for the Leiden physicists than the special theory had been. Lorentz for instance had been working on gravitation before and could now do so with a theory that could more naturally be related to that subject than his own electron theory. As we have seen, Lorentz had considered special relativity as an alternative formulation of his own work. The general theory, however, was much more than that, and was therefore much more appealing to Lorentz. As general relativity explicitly addressed gravitation, and was a theory about the structure of the universe, it was also much more interesting to De Sitter. For the mathematicians Schouten and Struik the same applied: where special relativity had almost no impact on mathematics, general relativity used state-of-the-art differential geometry, and consequently was also interesting from a mathematical point of view.

Even to Van der Waals jr., who had heavily criticized relativity theory in the period 1909-1913, relativity became much more appealing after the publication of the general theory. Although the idea that Van der Waals was a persistent opponent of relativity theory might have arisen from previous studies,[134] I have found no evidence that he reacted at all to relativity in the remainder of the 1910s. Illustrative for his silence is the fact that in an article about "the measurement of time", Van der Waals did not refer to Einstein, relativity or Lorentz even once.[135] When in the early 1920s, Van der Waals published on relativity again, he on the other

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[130] *Ibid*., p. 45.
[131] See e.g. Kerszberg, "Relativity of Rotation" and Janssen et al., *Collected Papers 7*.
[132] Fokker, "Summary".
[133] Eddington urged De Sitter to shorten his articles to get them published as soon as possible; De Sitter's first article appeared in Britain appeared in September 1916. See Röhle, *Willem de Sitter*, pp. 161-164.
[134] See e.g. Van Lunteren, "Natuurkunde en Democratie", p. 102 and Baneke, *Synthetisch Denken*, p. 156. Maas, in *Atomisme*, p. 152, also argues that Van der Waals only became convinced of relativity after 1920.
[135] Van der Waals jr., "Over het meten".

hand had become quite positive,[136] although he still regarded its foundational implications hesitantly. Van der Waals defended Kantian concepts as absolute time and Euclidean geometry, and reacted reservedly to relativity's implications for metaphysics. Nonetheless, Van der Waals admired the beauty of Einstein's theory, and was especially pleased with Einstein's extension of the principle of relativity to frames in any sort of motion. Van der Waals authored several popular publications on relativity, in which he both expressed his admiration and his reservations.[137]

Van der Waals was no exception in writing popular expositions of Einstein's work. Relativity in fact soon became a favourite topic in public lectures given by physicists. The first two public accounts on the theory of relativity, besides Van der Waals' dismissal of it in 1909, were the aforementioned inaugural lecture of Ehrenfest in December 1912 and Lorentz' exposition of the theory in March 1913. Although the initial popularization of relativity theory was aimed at a scientifically educated audience existing mostly of doctors, chemists and engineers, Lorentz and Johannes Kuenen, the third professor of physics in Leiden occupied mostly with educational duties, soon published expositions of relativity in leading cultural journals.[138] As will be discussed in the next chapter, the number of popular publications would grow rapidly over the late 1910s and early 1920s.

Einstein's relation with Dutch physics took another turn when Einstein himself was appointed as special professor in Leiden in 1920. After a period of concentrated correspondence between the two physicists, Lorentz offered Einstein a chair as 'special professor' in Leiden in December 1919. Interesting in their correspondence of that period, is that Einstein's thoughts on relativity and the ether moved towards those of Lorentz. In November 1919, in a reply to a telegram in which Lorentz had reported on the British confirmation of gravitational light-bending, Einstein admitted to Lorentz that his denial of the existence of the ether was too strong. Instead, Einstein added, he should have claimed that only the velocity of the ether was non-existent. Besides that, Einstein also declared that his previous idea of a 'closed space' was not conclusive; it was, again as Lorentz seems to have anticipated, only one of the possible solutions to a problem in general relativity. Lorentz subsequently advised Einstein to publish his new thoughts on these matters, which Einstein did in his inaugural lecture in Leiden.[139]

Besides scientific motives, there were also political reasons for Einstein's appointment in Leiden. These become clear from a letter in which Ehrenfest wrote to Einstein: "I believe that you, by spending a few weeks here, will contribute enormously, in an undemonstrative but therefore all the more powerful way, to the reestablishment of many disrupted scientific relations."[140] Of course, Einstein was foremost a world-class physicist, and his close personal contacts with the Leiden professors certainly facilitated his appointment. His pacifist ideals and labour towards international scientific reconciliation were however also certainly important factors in his appointment, as these ideals were very much shared by the elite at Leiden University.[141] In fact, a large part of the 1919 correspondence between Lorentz and Einstein had been dedicated to this subject. On April 26, Einstein had asked Lorentz' for help in finding colleagues from in particular France and Belgium, who, like Einstein, were willing to end

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[136] E.g. Van der Waals jr., "Over de ruimte", p. 84, and *De relativiteits-theorie,* p. 94.
[137] *Ibid*, see also Van der Waals jr., *Over den wereldaether*.
[138] In *Onze Eeuw*: Lorentz, "Lichaether" (1915); in *De Gids*; Kuenen, "Relativiteitstheorie" (1917).
[139] Einstein**,** *Äther*. See also Illy, "Einstein Teaches Lorentz", pp. 277-278.
[140] Cited in Van Dongen, "Mistaken Identity", p. 131. Ehrenfest to Einstein, December 9, 1919, in Kormos Buchwald et. al., *Collected Papers 9*, pp. 286-289, citation on p. 286.
[141] See Van Dongen, "Mistaken identity" on the political motives behind Einstein's appointment. On the Dutch attempts of scientific reconciliation, see Otterspeer & Schuller tot Peursum-Meijer, *Wetenschap en wereldvrede*.

hostilities between the scientists of both sides.[142] Lorentz and Einstein, who both had regretted the breakdown of scientific relations already during the war (Einstein blamed these hostilities on "collective delusions"[143]), corresponded extensively in the summer of 1919 on how a committee of such scientists could be composed.[144]

As both the attempts at popularization of relativity theory and the political motives behind Einstein's appointment show, the Leiden group was clearly trying to influence public opinion, not only on science, but also on intellectual life in general. When the 'scientific reception' of relativity was completed, in the sense that Dutch physicists had both accepted the theory and had started working on it, they immediately set out to accelerate and strengthen its public reception. Whether they were successful in doing so be discussed in the next chapters.

[142] Einstein to Lorentz, April 26, 1919, in Kox, *Lorentz Correspondence*, pp. 504-505

[143] "Kollektivwahn", Einstein to Lorentz, July 26, 1919, in Kox, *Lorentz Correspondence*, p. 510.

[144] Einstein to Lorentz, April 26; Lorentz to Einstein, May 4; Lorentz to Einstein, July 26, Einstein to Lorentz, August 1; Einstein to Lorentz, September 21; Kox, *Lorentz Correspondence*, p. 504-513. These issues will be discussed in more detail in chapter five.

4. Popularizing relativity theory, 1909-1920

Thus, relativity theory became the leading theory in Dutch electrodynamics around 1912-1913 when Ehrenfest came to Leiden and Einstein started working on his general theory of relativity. Physicists from Leiden immediately after that took up the popularization of relativity: Lorentz gave semi-popular lectures on the theory already in 1913. Continued efforts to educate the public about relativity were made by the Dutch physics community during the rest of the 1910s. Einstein and his theory however only became subject of major public discussion after Eddington's confirmation of gravitational light-bending. This chapter discusses popular reactions to Einstein and his relativity theory before that. Dutch physicists were of course responsible for introducing relativity theory to the public, as Einstein's theory did not automatically lead to increased interest. Therefore, special attention will be paid to the role of popular publications and lectures of Dutch experts.

The central question in this chapter is how Einstein's relativity in fact did become popular in the Netherlands. I will describe the popularization by scientists and the early public reception, which together will form the background for the mass reactions after Eddington's confirmation of relativity. The early reception is however not only interesting as background. As relativity did not yet hold any extraordinary status among the public during the 1910s, studying its early reception allows for a balanced account of how science *in general* was perceived, more so than could be deduced when focusing only on the mass reactions in the 1920s. Contrasts between the early reception and the situation after the confirmation of gravitational light-bending, can therefore also shed light on how exactly the widespread interest after 1919 deviated from earlier popular reactions to science. Hopefully, this will help in determining what images of science existed among the Dutch public, and what, if anything, was expected from the scientific enterprise. It is also very interesting to see whether there was any interaction between these public images of science and public behaviour of scientists. A comparison between views on the role of science held by academics themselves – as were discussed in chapter two – with actual public reactions to science, will hopefully make interactions between science and its various audiences somewhat more clear.

In order to discuss these issues, its is necessary to consider the actual public of popular science: in which parts of society was 'the public' actually in touch with science, and who responded to Einstein's theory? How did the popular reception of relativity evolve in that respect? The reactions that I will discuss, mostly come from three types of media: newspapers; general political and cultural journals; and magazines specialized in popularizing science, such as the journal of engineers, a philosophical journal and some magazines dedicated to the spread of scientific knowledge. Especially for newspapers, but also for the cultural journals, it is important to consider their ideological background. The social fragmentation of the Netherlands had a huge impact on media in the interwar period. Specific newspapers existed for each ideological group, and the interpretation of news was very much subject to pillarization. Because of that, it is often quite clear to what public certain articles are addressed, but one has to be careful to avoid mixing up ideological based rhetoric with the 'content' of articles. As far as possible, I will try to describe the background of media and people involved.

This chapter will be used to provide an overview of the early impact of relativity theory in the Netherlands, and will supply detailed information on which of the Dutch newspapers and journals were attentive to scientific developments in the period before the outbreak of public interest in relativity. It will also give a detailed account of how popularization of Einstein's theory by the Dutch physics community created a background for the overwhelming interest in relativity theory and its creator after their international rise to fame in 1919. The period around

that rise to fame is shortly discussed at the end of this chapter. The next two chapters, then, will focus, respectively, on the public interest in the *person* Einstein in the light of his appointment in Leiden; and the incorporation and uses of relativity in philosophical, cultural and political debates in the Netherlands in the early 1920s. Together, these chapters will provide a survey on the public status of relativity and the scientists involved, and will hopefully be helpful in understanding the role and position of science in general in Dutch interwar society.

Early public encounters with Einstein

The first two public discussions of relativity in the Netherlands, the inaugural lectures of Van der Waals jr. in Amsterdam and Ehrenfest in Leiden, respectively in 1909 and 1912, have already been discussed. Although being specialist treatments to a certain extent, these lectures were immediately picked up by one of the leading liberal newspapers, the *Algemeen Handelsblad*, which provided summaries of both these lectures.[145] This however had nothing to do specifically with public attentiveness for the theory of relativity: summaries of semi-popular lectures like these were quite common in Dutch newspapers in the first decades of the twentieth century. Before 1919, printed versions of public addresses by physicists such as Lorentz, Fokker and Ehrenfest would make up the largest part of the coverage on Einstein and relativity.

As could be expected on the basis of the scientific reception, Dutch physicists started popularizing relativity theory in 1913, after Ehrenfest had been appointed in Leiden. The *Handelsblad* also provided accounts of Lorentz' first series of popular lectures in Teyler's museum,[146] and Lorentz himself additionally lectured on Einstein's work on relativity theory for the *Genootschap ter bevordering van genees- heel- en verloskunde* (Society for advancement of medicine, surgery and obstetrics). This lecture was printed in full in the leading Dutch medical journal,[147] and summaries were given not only in the *Handelsblad*, but also in the *Nieuws van den Dag* and the *Nieuwe Rotterdamsche Courant* (*NRC*).[148]

The *NRC* had a background quite similar to the *Handelsblad*: both were elitist, liberal newspapers, and small notices as well as longer articles on science were published regularly in these two newspapers. As higher education was still a concern of the elite, attention from these elites for special occasions at the universities is hardly surprising. The *Nieuws van den Dag* on the other hand, was intended for the 'middle class', and its interest in science originated from its goal of education and enlightenment of the common people. Huub Wijfjes, historian of Dutch media has described the *Nieuws van den Dag* as a "very civilized" newspaper with "high morals".[149] As discussed in chapter two, educational reform was actually accomplished in the period around the First World War, and in 1917, the university became much more accessible for the middle-classes. Interest from these classes in science presumably was growing, and a newspaper like the *Nieuws van den Dag* obviously tried to satisfy the demand for knowledge by publishing scientific lectures.

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[145] For Van der Waals' lecture, see *Algemeen Handelsblad*, January 18, 1909, p. 1, "Rede van prof. dr. J. D. van der Waals Jr.", Ehrenfest's lecture was summarized on December 4, 1912, p. 7, "De crisis in de hypothese van den lichtaether".
[146] See *Algemeen Handelsblad*, March 4, p. 7; March 11, p. 6; and March 18, 1913, p. 7, "Voordrachten van prof. dr. H. A. Lorentz in Teyler's stichting".
[147] Lorentz, "Nieuwe richtingen".
[148] See *Nieuws van den Dag*, October 22, 1913, p. 12, "Genootschap voor Natuur-, Heel- en Geneeskunst"; *NRC*, October 22, 1913, p. 1, "Genootschap ter bevordering van Natuur-, Genees- en Heelkunde"; *Algemeen Handelsblad,* October 23, 1913, p. 2, "Genootschap ter bevordering van Natuur-, Genees- en Heelkunde".
[149] Wijfjes, *Journalistiek*, p. 85 and p. 90.

In both his lecture for the medical society and his earlier addresses at Teyler's museum in March 1913 which was intended for high school teachers,[150] Lorentz introduced Einstein's work on special relativity as the latest extension of the electrodynamics of moving bodies, in succession to both his own electron theory and earlier work by such physicists as James Maxwell and Abraham Michelson. This was exactly the same way in which Einstein's work had initially been perceived in Germany, and for Lorentz, as we have seen, special relativity was certainly not something very spectacular in 1913. Lorentz' lecture for the medical society was however held in October 1913. At that time, Einstein had already started working on a generalized version of the theory of relativity. In August, Lorentz and Einstein had started their correspondence on the new theory. In his October lecture, Lorentz now ended his discussion of relativity theory with Einstein's work on gravitation and the hypothesis of gravitational light-bending. If this prediction would turn out to be correct, then, according to Lorentz, "Gravitation would no longer be an unrelated action without any connection with other effects."[151] Where Lorentz was somewhat reserved on special relativity, he in fact presented general relativity and the incorporation of gravitation as a fundamental revision of physical thought.

By the time Lorentz held his next popular address in April 1915, Einstein however still had not managed to fully work out his gravitational theory, and Lorentz focused on the differences between Einstein's special relativity and earlier theories instead. Lorentz' 1915 lecture was held for the entire Royal Academy of Sciences, including its department of letters, which members would for instance be scholars of the humanities or law. This particular lecture would become the first account on relativity to be published in a cultural journal in the Netherlands: the full lecture was printed in *Onze Eeuw*.[152] In contrast to his earlier public addresses, Lorentz' lecture for the Royal Academy hardly used any technical language or mathematical symbols. Its publication in *Onze Eeuw* was therefore the first discussion of relativity understandable for a large audience. Lorentz clearly pointed out the differences in the conceptions of space and time between the older 'aether-theories' and Einstein's 'principle of relativity', and remarked that although many physicists now accepted the relativity interpretation, those who were a little old-fashioned still had some doubts.[153] Even though Lorentz himself was one of these "old-fashioned physicists", he obviously felt the need to popularize the new theory, an urge which was only intensified when Einstein managed to complete his work on general relativity in the fall of 1915.

Spelling out conceptual difficulties in the theory of relativity became fashionable in experts' public addresses, and in lecturing on relativity, Lorentz was soon joined by his colleagues. Henk Klomp has provided an extensive list of such semi-popular lectures in his dissertation on relativity theory in the Netherlands.[154] Among scientists lecturing on relativity were of course Ehrenfest and Fokker, with Ehrenfest being responsible for initiating interest in relativity in the Netherlands, while Fokker had worked with Einstein himself in 1913-1914. Although physicists from Leiden were the first heralds of relativity, other scientists presented lectures on the theory even before 1919. For instance M.J. van Uven, professor of physics and mathematics at the Wageningen agricultural academy, lectured several times on relativity

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[150] See Lorentz to Woldemar Voigt, March 2, 1913, in Kox, *Lorentz Correspondence*, pp. 370-371, in particular Kox' comment on note 4.

[151] Lorentz, "Nieuwe richtingen", p. 2178: "De zwaartekracht zal dan niet langer een op zich zelf staande werking zonder eenigen samenhang met andere verschijnselen zijn."

[152] Lorentz, "De lichtaether".

[153] *Ibid*. p. 37.

[154] Klomp, *De Relativiteitstheorie*, p. 233. Klomp's list is substantial, but could certainly have been much longer. Some of Lorentz' addresses, for instance the one he presented for the medical society in 1913, are not included, and neither are any lectures by for instance Van Uven.

theory in the period 1917-1922.[155] Philip Kohnstamm, professor of physics in Amsterdam and chairman of the *Genootschap ter bevordering van natuur- genees- en heelkunde* (Society for promotion of natural sciences and medicine), invited Ehrenfest and Fokker to present lectures on relativity for that society in 1917. In January 1918, an engineer by the name of P.M. Verhoeckx, who would in 1919 also publish on relativity, lectured on the theory for the 'Society of Engineers in South-Limburg'.[156]

In the meantime, Einstein's name was increasingly appearing in Dutch newspapers. His works on light-quanta on the one hand and Brownian motion and molecular theory on the other were already mentioned in lectures in 1909 by Lorentz and the chemist F.M. Jaeger. Accounts of these lectures were published in the *Handelsblad* and *Nieuws van den Dag*.[157] The *Handelsblad* also eagerly reported on a visit Einstein made to Leiden in 1911. At that point, Einstein's studies on light-quanta and molecular theory were still considered his main contributions to physics, and coverage focused on those subjects. Nonetheless, some of Einstein's ideas on relativity theory were referred to. The *Handelsblad*, which published both a preview of Einstein's lecture and an account of the lecture itself,[158] and referred to a students' journal for information in its preview, described relativity as a "positivistic principle" which stemmed from the impossibility to demonstrate the existence of absolute motion. There was however as yet no evidence for Einstein's conclusion that "inertia of a body would depend on its energy-content", and neither, still according to the *Handelsblad*, for a small adaptation of Newtonian gravitation supposedly argued for by Einstein. Although the *Handelsblad* was able to list some of Einstein's conclusions, it was in no sense aware of a concept like 'the theory of relativity' or the fact that Einstein argued for a radical revision of the concepts of space and time, which certainly was special relativity's most important point. Einstein himself probably did not use his visit to Leiden in order to clear up any misconceptions about relativity, as he chose to lecture on molecular theory and Boltzmannian thermodynamics instead.[159]

As these difficulties and misconceptions were in all likelihood only taken care of by Ehrenfest in December 1912, the Dutch public did not become acquainted with 'Einstein's relativity theory' before 1913. Nonetheless Einstein was mentioned on some other occasions prior to that in the Dutch press. In 1911, for instance, Leonard Ornstein, at that time a student of Lorentz, related "research by Lorentz and Einstein" to problems in thermodynamics; Lorentz himself spoke about Einstein's energy-mass relation for the Royal Academy.[160] In any case, popular lectures would remain the main source for publications on relativity in newspapers during the 1910s.[161]

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[155] See e.g. Van Uven, "Het relativiteitsbeginsel"; and *De Ruimte*.
[156] Klomp, *De Relativiteitstheorie*, p. 233. See Verhoeckx, *De vierdimensionale wereld*.
[157] See *Algemeen Handelsblad*, April 17, 1909, p. 1, "Natuur- en Geneeskundig Congres" and *Nieuws van den Dag*, March 22, 1909, p. 23, "Prof. Jaeger te Groningen". Van der Waals' lecture on relativity preceded these two by a couple of months, as it appeared in January 1909.
[158] *Algemeen Handelsblad*, February 7, 1911, p. 7, "Prof. Einstein" and February 11, 1911, p. 2, "Prof. dr. A. Einstein uit Zurich te Leiden".
[159] See the article of February 11 in *Algemeen Handelsblad*.
[160] *Algemeen Handelsblad*, April 21, 1911, p. 7. "XIIIe Nederlandsch Natuur- en Geneeskundig Congres" and June 24, 1911, p. 11, "Kon. Akademie van Wetenschappen".
[161] Further public addresses mentioning Einstein and being reported in newspapers were for instance: *NRC*, "Intreerede van prof. dr. P.J.W. Debije" and *Handelsblad*, "De atoom-theorie", September 30, 1912 (p. 6 and p. 14) on Debije's inaugural lecture in Utrecht; *NRC*, September 26, 1913 p. 9, "Wetenschappelijke berichten", by Einstein himself; *Algemeen Handelsblad*, December 3, 1914, p. 9, "Materie als meetkundige grootheid", about Fokker's inaugural lecture in Delft; *Algemeen Handelsblad*, September 30, 1916, p. 6, "Koninklijke Akademie van Wetenschappen", a lecture by De Sitter for the Dutch Royal Academy of Sciences; *NRC*, April 12, 1917, p. 9, "Zestiende Ned Natuur- en Geneesk. Congres.", *Algemeen Handelblad*,

The influence of Dutch scientists on public reactions is striking, especially in the period up to 1915. The general idea of relativity in the Netherlands was that relativity was a continuation of Lorentz' earlier work, as Lorentz himself would argue. Implications of the theory were not considered to be far-reaching. This was, unsurprisingly, exactly what the *Handelsblad* also concluded from its sources among Leiden students, and was in general how other scientists spoke about relativity. Newspapers certainly did not question the authority of those scientists, as they probably did not have the space nor the knowledge to publish anything else on what could be considered at that point just another piece of physics. However, we will see that journals reacted in the same way to the authority of science and the physicists' wish to popularize relativity, even though one might expect more detailed coverage from highbrow and specialized journals.

Experts and public reactions in the 1910s

After 1913, several journals quickly picked up on the new relativity theory. In *De Ingenieur*, the journal of the Dutch society of engineers, G.J. van de Well, himself an engineer, wrote a treatise in September 1913 on the history and recent developments in relativity theory, a treatise which was clearly influenced by Lorentz' lectures in March 1913.[162] *De Ingenieur* was mostly dedicated to technical innovations and problems directly related to engineering, but in many issues, articles on theoretical issues and fundamental physics were included. Especially electromagnetism was a popular topic in *De Ingenieur*, as it was closely related to technological developments in fields such as telegraphy and radio technology. As special relativity was considered to be an extension of the electrodynamics of moving bodies, the theory was probably believed to be of interest to engineering practices.

Expositions of relativity theory were also published in two popular-science magazines, *De Natuur* and *Vragen van den Dag*. In the latter, another engineer, W.L. Brocades Zaalberg, wrote in February 1915 about the fact that while Lorentz could only "retain the aether by forming strange hypotheses about its deformation", Einstein had chosen to abolish it, and also to "interpret not only movement but also time as something relative".[163] In the September edition of *Vragen van den Dag*, the same Brocades Zaalberg published on the history of the concept of the aether. In this article, similarities with Lorentz' address of April 1915 are immediately evident, as Brocades Zaalberg argued that although Einstein had removed the aether with his 'principle of relativity', in some situations it was still easier to use this concept of the aether.[164] Along the same lines, G.C.A Valewink, who had attained his doctor's degree in mathematics and physics under supervision of the mathematician W. Kapteyn in 1905, argued in *De Natuur* in 1915 that the question "whether the (hypothetical) concept of the ether would be abolished for good from physics, can not be answered yet".[165] According to Valewink, such questions could only be answered by the experts: "Lorentz, FitzGerald, Einstein, Minkowski, Ritz and others have spoken – we can only listen, that is try to understand and comprehend this".[166] *De Natuur* had a

April 13, 1917, p. 5, "Zestiende Nederlandsch Natuur- en Geneeskundig Congres", and *De Telegraaf*, April 13, 1917, p. 4, "Rede prof Lorentz", on a lecture by Lorentz for the Dutch scientific and medical Congress.

[162] Van de Well, "Het relativiteitsbeginsel" (1913).

[163] Brocades Zaalberg, "De natuurwetenschappelijke revolutie", p. 72.

[164] Brocades Zaalberg, "De cirkelgang", p. 590.

[165] Valewink, "Over het relativiteits-principe", p. 79. "Of 't (hypothetische) begrip 'ether' voor goed uit de physica verdwijnen zal, is dus nog niet te zeggen".

[166] *Ibid*., p. 80. "Lorentz, FitzGerald, Einstein, Minkowski, Ritz, e.a. hebben gesproken – aan ons is 't te luisteren, d.i. trachten te verstaan en te begrijpen".

direct connection with Hendrik Lorentz, as his daughter G.L. de Haas-Lorentz regularly published in the magazine in the period 1909-1915, when she was one of her father's students. The group around Lorentz and Ehrenfest itself produced numerous publications in the mid 1910s. Among these were articles by Fokker in *Vragen van den Dag* in 1918; by Lorentz in *De Ingenieur* in 1917; and, also in 1917, by Kuenen in *De Gids*, the leading literary journal in the Netherlands.[167]

De Gids, and *Onze Eeuw*, the latter had published Lorentz' 1915 lecture, where leading liberal journals, the counterparts of the *NRC* and the *Handelsblad*. Both journals regularly published on the natural sciences, mathematics and philosophy. Most of these articles were, as the publications on relativity already indicate, written by experts. In fact, from the mid 1910s on, both journals consistently had important scientists among their editors. Coverage on natural science became more frequent and specialized, paralleling the development of science itself. In 1913 Van der Waals jr. joined *Onze Eeuw* as editor, switching to *De Gids* in 1925 when publication of the former journal ceased. *De Gids* already had its own expert on relativity between 1916 and 1922 with Kuenen, and scientific expertise of *Onze Eeuw* was reinforced in 1920 by the appointment of Kohnstamm. In this period, an academic position became almost a necessity if one wished to publish on science in one of these journals. Articles on the sciences were therefore not 'public reactions' to science: on the contrary, they were popularizations, written by scientists themselves in order to educate the public. For instance Kuenen's article on relativity would do well in that respect; it would in fact become very influential. It was one of the first expositions of general relativity explicitly dedicated to a larger audience (Lorentz 1915 article in *Onze Eeuw* did not yet cover the general theory), and was cited frequently as an expert account when public reactions to relativity actually started to appear around 1920.[168]

Nevertheless, there were in fact some public responses to relativity before 1919, and they certainly were not all favourable. The earliest Dutch 'opponent' of Einstein's theory of general relativity was M.W. Polak, engineer and lecturer at Wageningen agricultural college. In 1918 he put forward his "objections to the conceptions of the relativists".[169] Polak continued his attack on relativity theory in 1919 with an article in *De Ingenieur*, in which he discussed why the theory could not be accepted. This article in turn spawned a polemic between Polak on the one hand, and Fokker and the aforementioned engineers Verhoeckx and Van de Well on the other.[170] Notably, Polak stated that even though Einstein's theory was unacceptable, he admired the beauty of his work, asserting that Einstein certainly would be recognized as a genius in the future.[171] Polak's main point of critique was that relativity of simultaneity was in conflict with common sense. He also criticized Einstein on issues which had to do with the equivalence of acceleration and gravitation in general relativity. Unfortunately for Polak, his arguments on the equivalence problem were flawed, and especially Fokker reacted with disdain, stating that for the interested reader looking for clear understanding, it was disastrous that Polak had published his thoughts in a book.[172]

When Polak subsequently complained about the unfair and uncivilized treatment of his work, and the fact that his opponents did not wish to disprove his central arguments, Fokker argued that Polak could not at all accuse him of trying to marginalize the engineer, as he had

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[167] Lorentz, "De gravitatietheorie"; Kuenen, "De relativiteitstheorie".
[168] See for instance *NRC*, November 9, 1919, p. 6, "Einstein's relativiteitstheorie"; Van Tongeren, "Het Relativiteitsprincipe" (1920), p. 80; Heymans, "Leekenvragen" (1921), pp. 92-93.
[169] Polak, *Bezwaren*.
[170] See Polak, "Is de Relativiteitstheorie te aanvaarden?"; Fokker, "anti-relativisme"; Van de Well, "anti-relativisme"; Polak, "Relativiteitsbeginsel"; Verhoeckx, "Relativiteitsbeginsel"; Fokker, "Zakelijk".
[171] See e.g. Polak, "Relativiteitsbeginsel", p. 441.
[172] Fokker, "anti-relativisme", p. 300.

reacted to several issues in personal correspondence between them. A review of Polak's book was out of the question for Fokker, as it would require at least another full book to straighten op all the misconceptions in Polak's work.[173] Whether or not Fokker tried to marginalize the engineer is debatable: the fact that he did not try to refute Polak's arguments and the sort of language that Fokker used, were however certainly were befitting for academic debate. In any case, it is evident that Fokker tried to control the popularization of relativity: the kind of discussion that Polak put forward was not deemed suitable by the experts.

Another early critic of relativity was the notorious agitator and Hegelian philosopher G.J.P.J. Bolland, professor in Leiden. In 1915, he condemned relativity for being nothing more than a trick of an overly mathematized physics. This was however a continuation of Bolland's earlier attacks on Lorentz and modern physics in general. Initially, Bolland had many followers among scientists, but his relentless attacks on modern science drove them away in the late 1910s and early 1920s. Two of Bolland's main physicist apostles were Fokker, who, in his dissertation, ironically thanked Bolland next to Lorentz, and Jacob Clay. Clay was just like Fokker a future professor of physics and student of Lorentz. Both Fokker and Clay were offended by Bolland's attacks on physicists, as well as by his attacks on the theory of relativity. As Bolland was one of the most influential philosophers in the Netherlands, Clay and Fokker could not react to him in the same way as Fokker had to Polak. They however did let Bolland know that they were offended by his attacks on Lorentz, and argued that those attacks were the consequence of a lack of understanding from Bolland's side. Clay and Schouten, the mathematician from Delft, protested the print of Bolland's 1915 lecture, as they argued that it abused science and contained many mistakes.[174]

The physician and well-known novelist Frederik van Eeden was probably one of the earliest non-specialists to react to 'relativity'.[175] He already wrote about the consequences of what is now called special relativity in 1911, of course reacting mostly to Lorentz' earlier work. Van Eeden however still credited Lorentz with relativity during the late 1910s.[176] One of his main interests were 'mystical' elements in science. Van Eeden already discussed four-dimensionality, which he considered as strengthening his points on mysticism and the limits of observation, long before it was incorporated in special relativity.[177] It can therefore be argued that Van Eeden, and the same holds for Bolland as well, did not react to Einstein or even relativity per se; Bolland and Van Eeden reacted to modern physics in general, and saw the same merits or inadequacies in Lorentz' work as they saw in Einstein's. Furthermore, they attributed relativity to Lorentz at least as much as to Einstein. Nonetheless, both made an impact on the later popular reception of the theory, as did Polak, who would persist in his critique on relativity and became involved in another couple of polemics with proponents of relativity in the early 1920s. I will come back to Bolland, Van Eeden and Polak in chapter six, when I will discuss popular criticism and interpretations of the theory in more detail.

Where Van Eeden at least initially reacted to relativity in a similar fashion as Leiden physicists did, Bolland in fact deviated from 'the authorities'. Clay's reaction to Bolland drew on the same ideas on the authority of science as that Fokker's response to Polak: both Clay and

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[173] Fokker, "Zakelijk". Polak's *Bezwaren* had in fact been reviewed by an unkown author. See "Review Polak", *Vragen van den Dag*, 33, 1918, p. 544.
[174] Otterspeer, *Bolland*, in particular p. 494.
[175] Van Eeden's involvement with relativity has been discussed in Klomp, *De Relativiteitstheorie*, and Vermeer, *Geestelijke lenigheid*.
[176] See for instance Frederik van Eeden, "Een waereld-gebeurtenis", *De Groene Amsterdammer* March 12, 1916, p. 1, where Van Eeden affirmed that although Lorentz was giving credit to Einstein, Lorentz himself was responsible for the new insights in physics.
[177] Vermeer, *Geestelijke lenigheid*, in particular p. 167.

Fokker argued that critics of relativity theory simply had not understood it. As the role of experts in popularization also indicates, physicists seem to have felt that only they had the competence to write, lecture, and comment on relativity theory. Such ideas of course would fit in well with an academic world that was becoming more specialized and professionalized each year. Nonetheless, the experts did start to introduce relativity to a wider audience in the second half of the 1910s. If they did not consider the 'public' competent in scientific matters, the question now is why they would bother to put so much effort in popularization.

Even if they found giving public lectures enjoyable, as was certainly the case for Lorentz,[178] could use the money generated by those lectures, as did Ehrenfest,[179] or felt that they were obliged to share most recent developments in their field with a large audience, this would not explain the scale of the popularization, or the way in which Leiden physicists seem to have tried to control the dissemination of relativity, as Fokker did in the case of Polak. Fokker apparently did not wish to react in public to Polak's book, but when Polak tried to win over a larger audience for his work, Fokker intervened and dismissed the engineer's ideas straightaway.

Fokker, a key figure in the popularization of relativity, in fact expressed his reasons for popularizing his work very clearly. In 1922, he wrote to Kuenen, who, as we have seen, was at that time editor of *De Gids*: "one would be inclined to despair of the fertility of the task to share the deepest thoughts of science with a broader audience; nonetheless, popularization is an inescapable task in order to maintain the viability of science, as far as it is not aimed at applications."[180] And similarly, in a 1923 review of a popular work on relativity theory by Van der Waals jr., Fokker argued: "it is almost of vital importance for our science, that the educated layman sympathizes with the results and thoughts of physics".[181] Fokker evidently was concerned with both the authority and legitimacy of science in the public perception. While he doubted that the public could really understand modern physics, public appreciation was still needed in order to secure the legitimacy of research, as there was no direct social benefit to be expected from theoretical physics. The fact that around the First World War, academics themselves more and more emphasized the practical uses of science, thus pressured scientists into popularizing their work, especially if it was considered to be 'fundamental research'.

The stream of popular publications on relativity theory thus coincided with a growing sense of urgency for creating broad support for fundamental research. Although the previous sections on the early popular reception of relativity do not indicate in any way the existence of significant negative reactions to the theory, let alone because of its 'fundamental' character, there are some indications that around the end of the First World War practical applications were indeed by some considered the most important consequences of science. A report in the left-wing liberal weekly *De Groene Amsterdammer*, which as regards to its presentation was somewhere midway between a newspaper and a journal, on the sixteenth *Nederlandsch Natuur- en Geneeskundig Congres* in 1917 illustrates this. At the congress, where *nota bene* Lorentz and Ehrenfest had been the opening speakers, and had lectured on general relativity and atomic

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[178] According to his daughter, see De Haas-Lorentz, *H.A. Lorentz*, p. 86.
[179] Hollestelle, *Paul Ehrenfest*, p. 189.
[180] Fokker to Kuenen, July 31, 1922. Cited in Klomp, *De Relativiteitstheorie*, pp. 54-55. "Men zou geneigd zijn, te wanhopen aan de vruchtbaarheid van de taak om de diepere gedachten van de wetenschap mee te delen aan een grootere schare; en toch is de popularisering een onafwijsbare plicht ter instandhouding van de levensvoorwaarden voor de wetenschap, voor zover die niet op het technisch gericht is."
[181] A.D. Fokker, "Review Van der Waals jr.", *Physica*, 3, 1923. pp. 62-63, on p. 62. Also cited in Klomp, *De Relativiteitstheorie*, p. 54. "Het is haast een levensbelang te achten voor onze wetenschap in de maatschappij, dat de ontwikkelde leeken medeleven met de uitkomsten en in den gedachtengang der natuurkunde".

theory, the reporter of the *Groene* was most impressed with developments in medicine. Although he seemed to have enjoyed the lectures by the two physicists, he recounted: "Immense was our awe for the most beautiful application of science: medicine. Healing … is more beautiful and more useful than theories on the movement of heavenly bodies or the structure of the atom."[182]

Physicists as Fokker considered the legitimacy of their discipline in peril, and tried to generate as much attention as possible. This was however in conflict with the wish to control the dissemination of knowledge and the demarcation between scientists on the one hand and 'incompetent laypeople' on the other. Popular work of course also contributed to the mass reactions to relativity after its confirmation in 1919, whereafter it became even more difficult for physicists to keep control over the dissemination of relativity theory. Whether the early public reception of relativity was influenced directly by an emphasis on applied science cannot be said with certainty, as there were virtually no reactions to relativity by lay people in the period before 1919. Indirectly however, the rhetoric around applied science certainly did influence the public reception, as it gave physicists another incentive to popularize Einstein's work.

Although taking exclusively reactions to relativity into account probably deforms the general picture, some preliminary conclusions about the interactions between scientists and their audience can be drawn. Although enthusiasm for applied science was probably more common in the 1910s, there are no indications of a lack of support or problems with legitimacy of fundamental research; 'utility' of research does not seem to have been a criterion to distinguish between disciplines in the first two decades of the twentieth century. Important to notice is that the popularization of science was largely controlled by scientists themselves. There were some journals that did focus on popular science, but articles in those magazines – at least articles on relativity – did not deviate from the consensus among Dutch physicists. In general, such articles would not amount to more than a representation of what the authorities would have said themselves. The fact that elite newspapers and journals reserved space for those scientists, of course says a great deal about the status of professional scientists. Remarkable is that most other media did not pay much attention to relativity, or to science in general: science was an elite enterprise. Apparently economic and social benefits of science were by the public not yet considered crucial: science was foremost appreciated because of its cultural value.

Eddington's 'test' and the outbreak of public interest

In 1919, relativity suddenly became interesting to other parts of the public. On the 6th of November, a team of British astronomers that included Arthur Eddington presented the results of their 'crucial test' of general relativity, by determining the magnitude of gravitational light-bending during a solar eclipse. This eclipse-experiment confirmed the values predicted by general relativity, and received wide press coverage. As a result of a well-executed media strategy, set into place already before the expedition, a genuine media-hype arose in the weeks after the presentation of the results.[183] Einstein was celebrated worldwide as the new hero of science, and the number of publications that addressed relativity theory and its creator exploded. In the Netherlands, the *Handelsblad* of course reacted immediately, translating a

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[182] See R.T.A. Mees, "Zestiende Nederlands Natuur- en Geneeskundig Congres", *De Groene Amsterdammer*, April 21, 1917, p. 2: "Maar groot ook werd ons ontzag voor de schoonste toepassing der wetenschap: de geneeskunde. Genezing… is schoner en nuttiger dan theorieën over de beweging der hemellichamen of van den bouw van het atoom."

[183] Stanley, "Expedition"; Sponsel, "Constructing a Revolution".

preview of the meeting from a British newspaper on the 7th November, and reporting on the meeting itself and its conclusions on November 10 and 11, still basing itself largely on its British counterparts.[184] The *NRC* similarly reported on November 9 that the results of the expedition had 'completely confirmed the theory of Einstein'.[185] Moreover, the *NRC* invited Lorentz to present his views on the confirmation of relativity, which were published on November 19.

Lorentz, as we have seen, had been engaged in intensive correspondence with Einstein during 1919, and was one of the main intermediaries between German and British scientists. Lorentz had been notified by the Dutchman Balthasar van der Pol, conservator of Teyler's museum, that preliminary results of Eddington's expedition already seemed to support Einstein's theory; Van der Pol had been present on one of the meetings of British scientists.[186] On September 22, Lorentz communicated these provisional results to Einstein, and on November 14, Lorentz telegraphed to Einstein that the results were fully in agreement with relativity.[187] Interestingly, in his reply, Einstein did not only thank Lorentz for his telegraph and for his hospitality during a recent visit in Leiden ("the day in Haarlem I was allowed to spend with you, is one of the most beautiful in my life"), he also thanked Lorentz for his inclusion in the *Bataafsch Genootschap*, one of the most important Dutch learned societies, for which the Leiden physicists had held numerous lectures on relativity.[188] Apart from his theory, Lorentz had thus also introduced Einstein himself to the Dutch public.

Lorentz' article in the *NRC* thus appeared only a couple of days after the cited letter, which was as a matter of fact the same letter in which Einstein had acknowledged some of Lorentz conceptions of the ether. In the *NRC*, Lorentz returned the favour. He lauded Einstein's achievements, and introduced relativity theory as one of the most important accomplishments ever in the natural sciences.[189] Furthermore, Lorentz reacted to the perceived unintelligibility of the theory of relativity. He asserted from British complaints in that direction that Einstein's own popular exposition of the theory had probably not yet been translated at the other side of the Channel. (This assertion turned out to be correct, as it was reported in May 1920 that Einstein's booklet on relativity would then be translated to English, as one of the first German books after the war.[190]) According to Lorentz, the fundamental ideas of the theory were actually simple and clear, only the mathematics involved were difficult. The simplicity of the theory was in fact the main reason why Lorentz felt that general relativity would stand the test of time. Relativity left much to the imagination, which enabled Lorentz to make a case for the ether once again. Although it would now have to conform itself to the new theory, Lorentz, backed by Einstein's reformulation of the concept, now argued that keeping the ether might have certain advantages, as different interpretations were only be helpful to innovation in experimentation. Lorentz concluded his article, which spanned almost an entire page in the newspaper, by pointing out Einstein's relation with the Netherlands: Einstein felt at home here, visited Holland regularly, and had many friends among Dutch physicists.[191]

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[184] *Algemeen Handelsblad*, November 7, 1919, p. 6 "De zoneclipse-expeditie in Brazilië"; November 10, p. 7, "De Proef op Einstein's theorie inzake het licht"; November 11, p. 6, "Einstein".
[185] *NRC*, November 9, 1919, p. 6, "Einstein's relativiteitstheorie". See also *NRC*, November, 11, 1919, p. 7, "Einstein's relativiteits-theorie".
[186] Kox, *Lorentz Correspondence*, p. 513.
[187] Lorentz to Einstein, September 22, 1919 and 14 November 1919 in Kox, *Lorentz Correspondence*, p. 513 and p. 516.
[188] Einstein to Lorentz, November 15, 1919, in Kox, *Lorentz Correspondence*, pp. 517-518.
[189] Lorentz, "De zwaartekracht".
[190] *Algemeen Handelsblad*, May 15, 1920, p. 2, "Wetenschap".
[191] Lorentz, "De zwaartekracht".

Lorentz' praises of Einstein were quite moderate compared to what had yet to come. Two days after the appearance Lorentz' article in the *NRC*, the *Handelsblad* published a summary of a speech by Ornstein, who, besides being a professor of physics, was at that time also chairman of the Dutch Zionist organization. Ornstein spoke about the Palestinian case, and claimed that negotiations for a Zionist homeland were going well. But the Jewish people could not only rejoice because of that: their efforts were strengthened by the support of the greatest minds among them, as they were actually mobilizing for the Zionist cause. First among these 'great minds' was of course Albert Einstein, "the equal of Newton" and '"the solver of the riddle of gravitation". Even though Ornstein indicated that there were other supporters among the 'great minds', he did not care to mention those others, as they were "the lesser of Einstein, even though being men of the highest rank".[192]

After this initial excitement around relativity, popular media started to react to the person behind the now revolutionary theory. A growing number of titles covered Einstein's undertakings after he rose to fame, and by mid 1920 Einstein had already become a celebrity. The popular *Rotterdamsch Nieuwsblad* for instance addressed the confirmation of relativity already shortly on November 11, 1919,[193] but its editors had probably forgotten this as another short article on the results of the eclipse experiment was published a couple of months later.[194] The Catholic *De Tijd* covered another field of Einstein-news, reporting under the header "narrow-mindedness?" that the British Royal Society would withhold its golden medal from "professor Einstein, the discoverer of relativity theory", after they had discovered that Einstein in fact was a German instead of a Swiss citizen.[195] On the same day, the liberal daily *Het Vaderland* reported that a lecture of Einstein had been hindered by protesting students, which its German source blamed on nationalist sympathies of the students, as Einstein 'stood very far on the political left'.[196] As we will see later on, *De Tijd* and *Het Vaderland* would become two of the newspapers most frequently covering Einstein's activities, together with the *Handelsblad* and *NRC*. Another title that would start to report regularly especially on Einstein himself after 1919 was *De Telegraaf*, a populist newspaper which was ideological 'neutral'.

The theory of relativity itself attracted attention too. The *Handelsblad* for instance published a large exposition of the theory by the mathematician Schouten in January 1920.[197] Interestingly, Schouten's article provoked a reaction of M.W. Polak, who again took the opportunity to make a case for common sense in physics. The scale of public interest in relativity is illustrated by the fact that Polak was permitted almost a full page in the *Handelsblad* to expound on his issues with relativity theory, while the polemic kept continuing on with an equivalently large reply by Schouten.[198] Similarly, in *De Natuur*, a student of the polytechnic university college in Delft by the name of Herman van Tongeren, produced a series of articles on relativity theory that ranged over sixty pages in total, and continued throughout 1920.[199]

In the Netherlands, a media hype was thus created alongside that in Britain. Interestingly, there are some clear similarities between the creation of public excitement in Britain, Germany and the Netherlands. Most important is that before excitement was aroused,

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[192] *Algemeen Handelsblad*, November 21, 1919, p. 1, "Opbouwfonds".
[193] *Rotterdamsch Nieuwsblad*, November 11, 1919, pp. 2-3, "De bouw van het heelal"
[194] *Rotterdamsch Nieuwsblad*, February 19, 1920, p. 14, "Kan het licht gewogen worden".
[195] *De Tijd*, February 14, 1920, p. 1, "Kleingeestigheid?".
[196] *Het Vaderland*, February 14, 1920, p. 3, "Een voorlezing van Einstein verhinderd".
[197] Schouten, "De theorie".
[198] Polak, "Tweegesprek", Schouten, "Ruimte en Tijd".
[199] Van Tongeren, "Het Relativiteitsprincipe". Another intersting publication on relativity theory appeared in *De Telegraaf* on April 14, 1920. See p. 9, "Over het relaviteits-principe", by a 'G.C.A.V.', possibly the aforementioned Valewink.

the theory first had to be publicly acclaimed by its protagonists. In Britain, Eddington and his collaborators had already raised interest in their work before the actual expedition took place, as they had claimed that their work would prove to be the crucial test between the gravitational theories of Einstein and Newton. Therefore the 'confirmation' of general relativity was in Britain immediately seen as an all-important result.[200] In the Netherlands, as discussed above, the *NRC* and the *Handelsblad* first covered the news in a matter-of-fact manner, and genuine excitement had to be aroused by Lorentz and Ornstein. The same happened in Germany, where the press initially "reacted far more soberly" to the confirmation of relativity, and the Einstein-hype analogously started out only when important newspapers started to press relativity-news to their public a month after the British announcement.[201]

[200] Sponsel, "Constructing a Revolution".
[201] Rowe, "Einstein's Allies", especially pp. 232-233.

5. The popular perception of Albert Einstein

In the fact that extensive coverage on relativity started in the Netherlands only after Eddington's eclipse experiments, the Dutch popular reception did not differ from those in other scientifically important countries such as Germany and Britain. There were however many differences in *how* the Dutch public reacted compared to those countries. The emphasis of this chapter will be on the 'general' public reception, which focused not so much on the theory of relativity, but especially on the person Albert Einstein. More elaborate popular responses and uses of relativity will be discussed in detail in chapter six. Although the respective receptions of Einstein and relativity were of course tightly intermingled, this division is a necessity. The very fact that Einstein's general theory of relativity was unintelligible for lay people, or was at least by many perceived that way, suggests that most public reactions to relativity *must* have been largely determined by factors other than appreciation of Einstein's work. This chapter focuses on that basic level where this was the case, by means of an analysis of predominantly newspaper coverage on Einstein. The next chapter discusses reactions that did address especially the importance, interpretation and value of relativity. Both chapters will deal with public engagement with science, but on a different level. This chapter gives information on 'science and the public' in a broad sense, namely on the perception of science by laypeople in general. Chapter six will cast light on the relations between professional scientists or experts on the one hand, and non-experts that actually wanted to be involved in scientific development on the other.

A quick look at familiar stories about public receptions of relativity shows that, especially in the German and French cases, the reception of Einstein and his theory was determined by political affiliations. Public reactions were not so much directed to relativity, but to Einstein personally instead. Issues with relativity, such as an alleged overuse of complicated mathematics, dissatisfaction with the perceived incomprehensibility of the theory, and the counter-intuitiveness of the relativity of simultaneity were linked to 'Jewish science' by Germany nationalist and to 'German science' by their French counterparts, both of course meant as derogatory designations. Einstein was a controversial figure not only because of his background and his science, but also because of his political views on internationalism and pacifism.[202] During the First World War, he had declined to sign the infamous Manifesto of the 93, and had instead argued for peaceful solutions, which were to be kept in place by supranational organizations. Furthermore, Einstein was a convinced democrat. He presented his stances on political issues openly and frequently. It is hardly surprising that those who opposed his politics were also more inclined to disapprove of relativity theory.

Einstein's background and his political views were however far less likely to stir up any controversies in the Netherlands than in Germany and France. Around 1920, anti-Semitism had not yet become a political factor in the Netherlands,[203] and the Dutch system was, as we have seen, rapidly democratizing. Einstein's views on pacifism were not problematic either, as the Dutch had actively retained their neutrality during the entire First World War, and considered themselves key players in normalizing political relations again in post-war Europe.[204]

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[202] On Einstein's political and idealist views, see Rowe & Schulmann, *Einstein on politics*.

[203] In his study of radical right-wing currents in Dutch interwar politics, De Jonge contends that only a latent form of anti-Semitism was present, and that this latent anti-Semitism was only activated in the 1930s. See De Jonge, *Crisis en critiek*, p. 25.

[204] For Dutch international politics in the aftermath of World War I, see Voorhoeve, *Peace, profits and principles*, Van Diepen, *Voor Volkenbond*. For the public opinion on these matters see Tames, *Oorlog*.

Furthermore, the fact that Einstein accepted a position at Leiden University of course influenced his reception in the Netherlands. As discussed in the introduction, and as will become clear from this chapter, the Dutch reception of relativity was, compared to the reception in other countries, relatively positive.

In the second part of this chapter, I will attempt to identify the various reasons for this 'positive reception' by singling out aspects in the reception of relativity that were typical for the Dutch case. Of importance were of course Einstein's relations with Dutch science and his appointment in Leiden. His political ideals, however, will also turn out to have been important in the creation of his positive image in the Netherlands. The first part of this chapter gives a more general overview of how Einstein was perceived in the Netherlands after he became a highly visible public figure. To what kind of subjects was Einstein related in the media? What does that say about public images of science and scientists? Besides the evident picture of a famous physicist, what images of Einstein were present in the media, and how did his Leiden chair influence these? The responses of Dutch newspapers are key in the next section, and I will try to make their reactions to Einstein as clear as possible.

Einstein imagery

On December 21, 1919, only a month and a half after the confirmation of gravitational light-bending, Lorentz offered Einstein a position in Leiden. Einstein had in fact turned down several calls from Leiden before, but this new offer must have been very much appealing to him. One reason for that was the fact that he would receive a substantial salary – Einstein at that point had troubles with providing financial support for his family in Switzerland because of the devaluation of the Deutsche Mark. Furthermore, Lorentz assured him that the position would come almost without requirements: Einstein just had to visit Leiden now and then. Persuading the faculty of science probably had been an easy task for Lorentz, as it was chaired by Kuenen at that time.[205] The university of Leiden quickly approved of Einstein's appointment, but, to the surprise of the physicists there, it took until September before the Dutch government finally ratified the appointment. The reasons for this delay give an interesting perspective on the public perception of the person Albert Einstein. Normally, professorial appointments were quickly approved of, but in this case, it took almost nine months before the Dutch government finally completed the appointment in September 1920. What was so special about Einstein, who, on basis of his reputation in physics, would of course be an asset to any university?

The problem arose from Einstein's supposed political sympathies. As we have seen, these were according to *Het Vaderland* to the 'far-left',[206] while the socialist journal *Het Volk* considered Einstein as a "fellow citizen in the endless realm of thought".[207] Einstein's ideas on socialism and democracy might in Germany have been considered by some as radical, and were certainly a factor in anti-relativity movements that will be discussed in more detail later. In the Netherlands however, Einstein's ideas were certainly not extreme. His democratic ideas were in fact quite moderate, and support for democracy was widespread in the Netherlands. Although Einstein's position in science was infallible and his colleagues in Leiden tried to convince the Ministry of Education that Einstein's political ideas were in no sense radical, Jeroen van Dongen

[205] Lorentz to Einstein, December 21, 1919, in Kox, *Lorentz Correspondence*, pp. 518-519.
[206] *Het Vaderland*, February 14, 1920, p. 3, "Een voorlezing van Einstein verhinderd".
[207] *Het Volk*, September 3, 1920, p. 1, "Broederschap".

has showed that around his appointment, the Dutch government nonetheless was afraid that Einstein might be a dangerous revolutionary after all.[208]

In the midst of all the confusion about Einstein's political views, preparations in Leiden continued. In May 1920, Einstein visited the university, even though his appointment was at that point far from completed. News about the upcoming appointment also reached the public for the first time in May. The *Handelsblad*, the *NRC*, *De Tijd* and *Het Vaderland* all closely followed Einstein's appointment as special professor in Leiden: they reported on May 18 about the fashioning of his chair;[209] stated that Einstein's appointment was almost completed on July 26;[210] and reported again on the 27th of October on Einstein's inaugural lecture when the appointment was finally completed.[211] Einstein's coming to the Netherlands was thus enthusiastically reported, even though the press was certainly aware of Einstein's socialist image. Other factors had made Einstein an admired figure, and his popularity at the time of his inaugural lecture is illustrated by the fact that even local newspapers like the *Leeuwarder Courant* reported on that lecture.[212]

The Dutch Ministry of Education was less carried away by Einstein's popularity. The Dutch government actually became wary of Einstein appointment when it took notice of the student protests referred to in *Het Vaderland*. This led to an investigation of Einstein's politics, and in the end to a private meeting between Minister of Education J.T. de Visser and the board of Leiden University on March 26. At that meeting, it turned out that the ministry had mistakenly confused Einstein with a true socialist revolutionary, a dr. Carl Einstein. According to Einstein's wife Elsa, though, this was as much Einstein's own fault as anyone else's, as she told him to do her a favour "and don't act like such a furious Socialist; you are not one any more so than Ehrenfest and many others!"[213] Carl Einstein on the other hand certainly was such a 'furious socialist'. He had played an important role in an uprising of German soldiers in occupied Belgium in 1918, and published several communist pamphlets in the years immediately after the war. Both Carl and Albert Einstein thus became public figures in the aftermath of the Great War. As they were both often mentioned in the media without first name, confusion between Albert and Carl could arise easily, especially as Albert too was considered as spokesman for leftish politics in the German press. It therefore took another couple of months before minister de Visser was finally certain that Einstein was not a zealous revolutionary. In October, Einstein was finally able to hold his inaugural lecture.[214]

The delay in his appointment was directly related to Einstein's image as a socialist: Dutch authorities were immediately alarmed whenever they encountered socialists. In fear of unrest, aroused by the situation in Germany, the Russian Revolution, and the subsequent failed call for revolution by the Dutch socialist politician P.J. Troelstra in 1918, the Dutch government was reluctant to appoint radical thinkers on public positions. This had cost for instance the renowned astronomer Anton Pannekoek a position as professorial astronomer in 1919.

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[208] Van Dongen, "Mistaken Identity".
[209] *Algemeen Handelsblad*, p. 2, "Prof. Einstein te Leiden"; *Het Vaderland*, p. 8, "Prof. Einstein te Leiden"; *De Tijd*, p. 7, "Prof. Einstein te Leiden". See also *De Telegraaf*, May 18, 1920, p. 10, "Prof Einstein te Leiden".
[210] *NRC*, p. 9 "Onderwijs"; *Algemeen Handelsblad*, p. 6, "Prof. Einstein"; *De Tijd*, p. 2, "Prof. dr. Einstein"; *Het Vaderland*, p. 2, "Prof. Einstein te Leiden".
[211] *Het Vaderland*, p. 6, "Intreerede van Einstein: De relativiteitstheorie en de aetherhypothese"; *NRC*, p. 9, "Aether en relativiteitstheorie"; *Algemeen Handelsblad*, p. 10, "Oratie prof. Einstein"; *De Tijd*, p. 10, "Onderwijs".
[212] *Leeuwarder Courant*, October 27, 1920, p. 3, "prof. Einstein".
[213] Elsa Einstein to Albert Einstein, after May 9, 1920, in Kormos Buchwald et al., *Collected Papers 10*, pp. 253-255. Cited in Van Dongen, "Mistaken Identity", pp. 137-138.
[214] Van Dongen, "Mistaken Identity"

Pannekoek had been working as a socialist ideologist in Germany in the years before the war. Although he had refrained from openly presenting his point of view after he had returned to the Netherlands in 1914, the government did turn Pannekoek's appointment down. Interestingly, the officials involved in Pannekoek's case were all fully aware of his political ideas from the very beginning; his appointment only became imperilled when the press took notice of his socialist sympathies. In the case of Pannekoek, the government seems to have feared public opinion. Caution was therefore necessary in Einstein's case too, even if Einstein's image was quite positive.[215]

That Einstein remained suspected of having socialist sympathies for the rest of his life is well known. In the Netherlands too, confusion about his political views continued to exist. The weekly *De Tribune*, affiliated to communist parties, wrote in 1921 that 'prof. Einstein' was a member of a committee that supported 'The Hungry in Soviet-Russia', and on the same page further referred to 'many high placed communists, among other Einstein'.[216] Whether *De Tribune* referred to the same Einstein here, or whether they were aware of Albert Einstein's political views is not relevant. Important to notice is that by the end of 1921, Einstein could still very easily be considered as a communist. *De Tribune* would of course react positively to a communist scientist; most other parts of society however would not. Yet, we will see in a moment that some of Einstein's political views, those being the ones that were most prominent in Dutch media, were in fact met with approval in 'public opinion'.

In any case, Einstein would continuously be related to radical politics and other modernist elements in the press. In an article on the trial of Henri Désiré Landru, a Parisian serial killer, *Het Vaderland* wrote that evidence against him had finally been collected. Scientists had found out that Landru had burned the corpses of his victims in his stove. Although the bodies had disappeared, enough human remains had been found to convict Landru. As *Het Vaderland* concluded, nothing could suddenly disappear into nothing, "whatever Einstein and other Dadaist among the modern physicists may claim".[217] The feeling that relativity theory was in some way related to avant-gardism was also suggested by a report on recent German lectures on philosophy in *De Tijd*. Its writer argued that Germans always had loved the kind of philosophy that was "dark and eccentric". The German defeat in the Great War had now caused an overturn of the 'power-based' philosophy of Nietzsche, which was "dethroned" and replaced by Einstein's relativity as the most popular philosophical system.[218]

Naturally, relativity theory was also frequently related to philosophical relativism. In 1923, when relativity already had been in the news prominently for a couple of years, a reporter of the *NRC* sighed: "Ah, relativity […] there is no absolute time and yet, yet, if it would be there, everything would still remain relative". The reporter then asked "what does the time between the things of the Pharaohs and that what is sculptured during the government of Queen Wilhelmina mean, when we consider art of the Ice Age?" A couple of thousand years was of course negligible compared to a period ranging over "fifty thousand years".[219] Similarly, the art critic J.J. Vürtheim, in a review of the drama "The Eccentric Guest", asserted: "we live in the era of the Einstein-theories, which demonstrate to us that everything is relative". Therefore, honesty was a relative virtue too. According to Vürtheim, this was in fact the main message of the play he

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[215] *Ibid*., pp. 153-155. On Pannekoek, see Baneke, "Afwijzing".
[216] *De Tribune*, November 4, 1921, p. 1, "Valsch Spel: Hoe "Het Volk" een schriftvervalsching klaar speelt".
[217] *Het Vaderland*, August 1, 1920, p. 1, "Uit het laboratorium van Désiré Landru".
[218] *De Tijd*, August 18, 1920, p. 5, "Twee vergaderingen".
[219] *NRC*, January 20, 1923, p. 16, "Vóór het Winkelraam".

was reviewing.[220] Jokes about relativity and relativism clearly had become commonplace, even in journals that had no link with science whatsoever. The same applied of course to mainstream media. The *Handelsblad*, in a fictitious article "Einstein anecdotes", related a story about a French lady who had visited one of Einstein's lectures. When her companion asked whether it had been interesting, she replied: "Well, it was all very relative". The rest of the audience had mixed feelings too: Einstein's talk had been "indigestible".[221]

This was certainly one of the recurring themes in the media: the supposed incomprehensibility of the theory of relativity. Especially in politics unclear arguments were frequently met with a quip about relativity. When covering an upcoming political conference in Washington, where among other things the British-Japanese alliance was at stake, *Het Vaderland* reported that "an American correspondent compared the explanations of the English with Einstein's theory, for simple mortals too obscure to explain it to them".[222] *De Tribune* likewise cited a British politician when the Labour Party voted on whether or not they would let a communist party join them. An opponent of this union stated that it was important to "pay attention to our leaders. But it is especially important to watch out for the new type of leaders, that understands as little about communism as they do about Einstein's relativity theory".[223] Although both these examples cited foreign sources for the claim that relativity was unintelligible – Dutch scientists had tried to avoid the establishment of this platitude as we have seen – the fact that such assertions were frequently made in the media, presumably established that view quickly in Dutch public opinion too.

Thus, as the previous sections demonstrate, Einstein's status rose rapidly after 1919. In the years after that, he became a celebrity whose ideas were used metaphorically to ridicule politics, art, science and philosophy. At the same time, Einstein's name would frequently be used to exemplify modern physics. In the early 1920s, the majority of important newspapers and cultural journals published at least one article meant to explain the core ideas of Einstein's relativity theory – as is discussed in the previous and next chapters. Even though relativity acquired the reputation of being incomprehensible, the fact that all these media provided popular accounts on Einstein's work demonstrates its popularity. In the press, Einstein and his theory thus soon became known as the newest and most spectacular achievement in modern science, which everybody needed to know of, despite the fact that only a handful of experts could really understand it.

Exactly that point was made by a certain J. Mulder in an article on modern mathematics education appearing in the *Vragen van den Dag*. Although he argued that mathematical insight was valuable in solving problems, repetition and exercises were often equally or even more important. Sometimes, it had to be that way, and Mulder provided evidence for that by referring to relativity: "It is a fact, that educated people too must follow scholars. It has to be that way […] we might be able to listen to Einstein, yet we cannot follow his thoughts."[224] Relativity was considered to be too difficult to understand. Nonetheless, people were fascinated by Einstein's theory, and especially by expert discussion about it. Dutch newspapers for instance enthusiastically reported in 1921 that the French mathematician and former prime minister Painlevé claimed he could refute relativity theory. The *NRC*, *Het Vaderland* and *De Telegraaf* informed the public that although Painlevé admired Einstein's theory, he thought that some of

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[220] J.J. Vürtheim, "De Zonderlinge Gast", *De Kunst: Een Algemeen Geïllustreerd en Artistiek Weekblad*, 16, pp. 209-210 (February 2, 1924).
[221] *Algemeen Handelsblad*, April 7, 1922, p. 5, "Onder de Streep: Einstein-anecdotes".
[222] *NRC* November 24, 1921, p. 5, "De toestand", where a statement by an English politician was compared to relativity theory, 'for ordinary people too abstruse to explain it to them'.
[223] *De Tribune*, June 24, 1921, p. 3 , "De bonzen der Labour Party tegen de Communisten"
[224] J. Mulder, "De resultaten van het onderwijs", *Vragen van den Dag*, 38, 1923, pp. 321-335.

its conclusions could be attained without making use of relativity.[225] These newspapers nonetheless emphasized that Painlevé had the utmost respect for Einstein; the argument between the two men was of a purely scientific nature. This was most certainly the case: Einstein was able to answer all of Painlevé's criticism, and after the former's visit to Paris in 1922, Painlevé het become convinced of the advantages that relativity offered.[226]

That relativity was the highest of the highest in science was an established idea, and arguments between scientists did not change that. The eminent scholar of East-Indies law Cornelis van Vollenhoven for instance argued in *De Gids* that a proponent of a new system of Indonesian polity "looked at his own fabrication with ecstasy, as were it Saint Thomas' Summa or the relativity theory of Einstein".[227] Van Vollenhoven's point here was evidently that the deviser of this system was so blinded by his own work that he considered it infallible; apparently relativity seemed to be so too. As Van Vollenhoven actually played an important role in Einstein's appointment in Leiden – I will come back to that later – his thoughts might have been coloured by his personal preferences. His evaluation of relativity however was quite common. For instance art critic J.C. Hol in 1921 referred to relativity as new and exciting too. He complained in *De Gids* that the famous French playwright Henri-René Lenormand (Hol noted that his wife was Dutch) exhibited some form of snobbery by including "the newest piece of science (Einstein)" in his play *Le temps est un songe*. According to Hol, the most actual 'bits' of science and philosophy could only be processed in literature harmlessly whenever the writer was "thoroughly familiar" with those bits. Putting 'Einstein' in a play did not make sense, as, to Hol, Einstein's discoveries had impact only on the scientific sphere. Clearly, Lenormand had not understood that.[228]

This idea, that the supposed influence of relativity on philosophy and 'worldviews' was overestimated, became more and more pronounced, especially from 1923 onwards. Instrumental for that was the "Einstein Film", a movie about relativity theory which was premiered in the Netherlands in February 1923. The Einstein Film was widely advertised in the newspapers,[229] and, according to its producers, served educational purposes. The film, a German production, presented only the special theory of relativity, and made use of state-of-the-art trick shots. Despite that, the German public in general still considered relativity incomprehensible. As Wazeck asserts, "the average cinema audience, however, was hopelessly overwhelmed and lost when viewing the Einstein film".[230] The same applied in the Netherlands. After seeing the movie, a journalist of the *NRC* wrote that the immense popularity of relativity theory was somewhat strange, as the subjects Einstein was involved with had nothing to do with day-to-day life, and did not "change anything about the worldly events as the average person observes them". Furthermore, the reporter affirmed that although the movie was instructive in many ways, the

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[225] *NRC*, October 20, 1921, p. 3, "Wetenschappelijke Berichten"; *De Telegraaf*, October 21, 1921, p. 9, "Einstein's theorie: critiek van Painlevé?"; *Het Vaderland*, October 22, 1921, p. 4, "Einstein en Painlevé"; *NRC*, October 25, 1921, p. 3, "Wetenschappelijke Berichten".

[226] For Painlevé's criticism and Einstein's response, see Paty, "Scientific Reception", pp. 146-148, and Van Kimmenade, *Resistance*, in particular pp. 96-98.

[227] C. van Vollenhoven, "De vinding-Ritsema van Eck", *De Gids* 88 I, 1924, pp. 317-339, p. 338.

[228] J.C. Hol, "Theater-Pitoëff", *De Gids*, 85 II, 1921, pp. 140-155, in particular pp. 146-147.

[229] See e.g. *Algemeen Handelsblad*, February 2, 1923, p. 12; *NRC* February 3, 1923, p. 10; *Het Vaderland* February 3, 1923, p. 8. News about this film was already reported on long before, see for instance *Algemeen Handelsblad*, August 31, 1921, p. 2, "Einstein gefilmd" – reports that a film will be made; *Het Vaderland*, April 5, 1922, p. 8, "De Einstein-films" – explains why the film is made, and what it will show; *NRC*, November 4, 1922, p. 5, "Einstein in de bioscoop" – on the popularity of the film in France.

[230] See Wazeck, "Einstein Film". Wazeck gives a description of the film and an analysis of its reception on Germany.

essence of relativity still remained unclear.[231] The same opinion was voiced by the famous Dutch novelist and poet Louis Couperus in *Het Vaderland*. Couperus was still startled by the fact that "thousands of people were interested in the, for most of them incomprehensible, ultrascientific and almost abstract realities" of Einstein's theory of relativity.[232]

In 1925, the furore about relativity had finally waned, as was expressed by historian of science E.J. Dijksterhuis, whose thought I will discuss in the next chapter. In 1925, Dijksterhuis claimed that "relativity theory no longer draws attention as it did a few years ago". About the theory's supposed influence, Dijksterhuis added: "the revolution in human thought expected from this theory, cannot be noticed as yet".[233] According to Dijksterhuis, who himself had certainly not expected such a revolution, relativity had thus initially been considered important from a philosophical point of view, and had therefore aroused public furore. In the course of the years, however, it had become clear that relativity's influence did not reach far beyond physics. Because of that, and because of the fact that relativity made use of highly complicated formulations, extensive knowledge about it was reserved to experts. Dijksterhuis would certainly agree with that, and so would Couperus, as he expressed in his comments on the Einstein Film.

Nonetheless, the Dutch press evidently treated Einstein as an icon of modern culture, and of modern science in particular. A story in *Het Vaderland* narrated a conversation on modern science between two gentlemen, also including a young lady who happened to confuse the theosopher Steiner, the physiologist Steinach and the culture critic Spengler. The conversation had however started with Einstein, "how could you not talk about him?"[234] In December 1921, the writer Annie Salomons, in a rubric "For Women" lamented the deplorable dilettantism that was required of all those who were well-educated. Salomons listed about a dozen issues on which such people (like herself) had to be informed. The list included political issues such as the League of Nations, "the Irish question" and Désiré Landru; academic debates on Montessori education, Bolland's philosophy and Steiner's theosophy; and the literature of the Indian Nobel Prize laureate Tagore. Salomons ended her list with the remark that she had not even begun mentioning the more special issues, "such as Einstein's relativity theory".[235] Einstein thus was part of the cultural discourse, but relativity was an unusual issue due to its specialized nature.

The public in general was therefore not as much interested in relativity theory as it was in Einstein personally. Einstein quickly became a celebrity and his comings and goings received considerable attention. Especially his trips to the United States and Britain in 1921, to France in 1922, and to Japan and Palestine in 1923 were extensively covered in Dutch newspapers. Einstein acquired the image of a cosmopolitan and became an "idol" according to *NRC*. Discussing the illustrated magazine *De Wereldkroniek* that specialized in glamour, the *NRC* agreed that "the people needs it idols" whether those would be Einstein and Tagore or the famous boxers Jack Dempsey and Georges Carpentier.[236]

Coverage on Einstein thus increasingly focused on details and his personal life. *Het Vaderland* for instance reported on the 29th of October 1921 that Einstein would return to Leiden in November, following up the day after with the message that in the next ten years, there

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[231] *NRC*, February 6, 1923, p. 1, "De relativiteitstheorie van Einstein in film".
[232] Louis Couperus, "Intieme impressies", *Het Vaderland*, February 18, 1923, p. 5.
[233] Cited in Van Berkel, *Dijksterhuis*, p. 150.
[234] *Het Vaderland*, April 16, 1922, p. 7, "Het Gesprek".
[235] Annie Salomons, "Bijkomstigheden", *De Groene Amsterdammer*, December, 24, 1921, p. 5.
[236] *NRC*, August 11, 1921, p. 9. Interestingly, the Berliner Illustrierter Zeitung published a cartoon of Einstein and Tagore too, on August 25, 1921, with the caption "Das Volk will Seine Götzen haben", see Wazeck, *Einsteins Gegner*, p. 92 and "Marginalization processes", p. 172.

were exactly twenty minutes to test the theory of relativity.[237] In 1923, the *Handelsblad* reported on a trip Einstein made to Japan, and paid special attention to the presence of Einstein's wife and the welcome the couple received in Japan.[238] A couple of weeks later, the *Handelsblad* published a report on Einstein's doings, written by its reporter in Japan. According to that reporter, the situation in Japan was incomparable with that in the Netherlands. Where the Dutch public would only cheer its sports heroes, the Japanese were full of excitement about Einstein's visit. The reporter added – ironically, as we have seen – that even ministers in Japan spoke about relativity and Einstein.[239]

Einstein's appointment in Leiden of course tied him personally to the Netherlands. One of the most intensively covered stories about relativity theory was an upcoming Dutch test of the theory that would take place during an eclipse in September 1922. This total eclipse attracted much attention of astronomers. As the British astronomer W.W. Campbell asserted, the "desirability of repeating the tests [that is, those of 1919] for the deflection of stellar rays […] is universally recognized".[240] A combined Dutch-German expedition was send to measure light deflections on Christmas Island, near the Dutch Indies. The expedition included the Dutch astronomer Joan Voûte from Java and Erwin Finlay-Freundlich, astronomer in Potsdam and a close associate of Einstein.[241] The British too would install a team at Christmas Island, and other Commonwealth expeditions would make measurements at the Maldive Islands and at several positions on the Australian mainland.[242] The *Handelsblad* first took notice of the upcoming eclipse in October 1921, when it reprinted an article from the *Soerabaiasch Handelsblad*.[243] Further reports on the expedition followed in April 1922, when it was also mentioned that the British would carry out a competing experiment during the eclipse.[244] Unfortunately, most of the experiments would fail due to bad weather conditions,[245] as was reported in the Dutch press.[246] In the meantime, however, newspapers as diverse as *Het Vaderland*, the *Rotterdamsch Nieuwsblad*, *De Tribune*, *De Tijd*, and the *Limburger koerier* had discussed the upcoming event.[247]

Einstein, as one of the most prominent scientists in the Dutch press, was of course a perfect figure to relate Dutch scientists to. As was discussed in the previous chapter, occasions such as professorial appointments were regularly reported in the press. In the early twenties, one could now read that for instance the mathematician L.E.J. Brouwer, who himself was quite famous, was allowed to lecture on the same spot where Einstein had discussed his research before.[248] Similarly, the physicist W.J. de Haas, Lorentz' son-in-law, was most well known for the

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[237] *Het Vaderland*, October 29, 1921, p. 2, "Einstein"; October 30, 1921, p. 6, "Twintig minuten in tien jaar".
[238] *Algemeen Handelsblad*, January 19, 1923, p. 9, "Uit andere landen: Einstein in Japan", *De Tijd*, January 20, 1923, p. 1, "Einstein in Japan".
[239] *Algemeen Handelsblad*, February 2, 1923, p. 2, "Japan: De Japanner en de vreemdeling".
[240] Campbell, "Total Solar Eclipse", p. 123.
[241] On Freundlich, see Hentschel, "The Einstein Tower".
[242] Campbell, "Total Solar Eclipse", Burman & Jeffery, "Wallal".
[243] *Algemeen Handelsblad*, October 28, 1921, p. 9, "Wetenschap: De Indische sterrenwacht".
[244] See for instance: *Algemeen Handelsblad*, April 6, 1922, p. 10, "Zoneclips-expeditie"; *Het Vaderland*, April 8, 1922, p. 3, "De zon-eclips op 22 September"; *Algemeen Handelsblad*, April 11, 1922, p. 10, "De Britsche Eclips-expeditie".
[245] Hentschel, "The Einstein Tower", p. 22. See also Burman & Jeffery, "Wallal", for a description of the Australian expedition that succeeded in testing general relativity.
[246] See e.g. *NRC*, October 3, 1922, p. 10, "De zonsverduistering".
[247] See for instance: *Rotterdamsch Nieuwsblad*, June 8, 1922, p. 10, "'n Totale zonsverduistering op komst"; *Rotterdamsch Nieuwsblad*, July 17, 1922, p. 15, "Een Einstein-expeditie naar de Christmas-eilanden"; *De Tijd*, July 17, 1922, p. 2, "neclips-expeditie naar Christmas"; *Het Vaderland*, September 3, 1922, p. 6, "De aanstaande zonsverduistering"; *De Tribune*, September 4, 1922, p. 3, "Zonsverduistering"; *Limburger Koerier*, September 13, 1922, p. 1, "De a.s. zonsverduistering en Einstein".
[248] *Algemeen Handelsblad*, December 6, 1921, p. 2, "Prof. L. E. J. Brouwer".

fact that he had shared a scientific prize with Einstein.[249] De Haas and Einstein had been awarded this prize, the Baumgärtner Prize of the Viennese Academy of Sciences of 1917, for their collaborative work on the influence of electrons on magnetic fields.[250] One of the effects they described was later named the Einstein-de Haas effect after them. When the astronomer J.C. Kapteyn passed away, his colleagues made sure that Kapteyn was related to Einstein, whether that was because Kapteyn and Einstein had been the star attractions at a recent conference in Potsdam,[251] or because Einstein had been in the audience when Kapteyn presented his last theory.[252] Scientists were, as discussed in chapter four, very much engaged with the prestige of their work; links to the cultural icon Albert Einstein would certainly enhance their visibility.

Dutch Zionists too were happy to relate themselves to Einstein: because of his work for the Hebrew University of Jerusalem,[253] Einstein soon became known as an ardent supporter of the Zionist cause. Ornstein had of course mentioned Einstein as supporter of Zionism already in the weeks after Eddington's confirmation; furthermore, Dutch newspapers reacted disdainfully to anti-Semitic attacks on Einstein in Germany.[254] Einstein embarked on his 1921 trip to America in order to acquire funds for the Hebrew university that was to be founded in Jerusalem, a trip that was closely covered by the media. The *NRC* and the *Algemeen Handelsblad* reported that the group Einstein was part of had collected three million in total for the Zionist cause, and that another million had been assembled specifically for the university.[255] Einstein own views on anti-Semitism were commented on in a substantial article in *Het Vaderland* in December 1920. Especially Einstein's opinion on assimilation of German Jews to Christianity was discussed, and the reporter of *Het Vaderland* agreed with most of Einstein's views. Furthermore, the reporter claimed that the situation in the Netherlands was much better as the "free Dutch spirit" did not demand or tolerate servility of others.[256] An article in the socialist journal *De Socialistische Gids* on the position of Jews in Weimar Germany did not only consider anti-Semitism against Einstein as abject, it was also happy to report that Einstein himself was a social-democrat.[257]

I will discuss Einstein's politics and their role his reception in the Netherlands in more detail in the next sections; at this point, I believe that media coverage on Einstein has been discussed sufficiently for our needs here, and I would like to draw attention to the main elements in the 'image' of Einstein in public opinion. To begin with, Einstein became a celebrity in the early 1920s, and was supported in his troubles with anti-Semites by the in the Dutch press. At the same time, relativity theory came to exemplify modern science and was related to subjects as widespread as unintelligible political moves, Dadaism, and German philosophy. The supposed avant-gardist nature of relativity was alluded to constantly, and connections with modernism and philosophy seemed to have made the theory very intriguing to the public. Einstein acquired an image as an objective and considerate person, and became an icon for

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[249] *Het Vaderland*, July 8, 1922, p. 2, "Prof. dr. W. J. de Haas" and *De Tijd*, July 11, 1922, p. 7, "Prof. De Haas".
[250] Van Helden, "de Haas", Maas, "The magnet". Maas contends that de Haas is still remembered mostly for his work with Einstein and the Einstein-de Haas effect.
[251] *Nieuwsblad van het Noorden*, June 20, 1922, p. 2, "Stad en Dorp: Groningen".
[252] *NRC*, June 21, 1922, p. 9, "Jacobus Cornelius Kapteyn". Fokker was also related to Einstein when he was appointed as professor in 1923 (see e.g. *NRC*, *Algemeen Handelsblad* and *De Tijd* on January 5, 1923), but as Fokker actually had been one of Einstein's students, this was of course less remarkable.
[253] See e.g Rosenkranz, *Einstein before Israel*.
[254] For instance *Nieuw Israëlietisch Weekblad*, September 3, 1920, p. 6, "Einstein"; *Het Vaderland*, August 5, 1922, p. 13, "Het leven van Einstein bedreigd?".
[255] *NRC*, June 13, 1921, p. 2, "Het Zionistische fonds voor Palestina"; *Algemeen Handelsblad*, June 14, 1921, p. 2, "Palestina: het opbouwfonds".
[256] *Algemeen Handelsblad*, December 23, 1920, p. 13, "Joodsche Tijd- en Strijdvragen".
[257] Eduard Bernstein, "De Joden in de Duitsche sociaal-democratie", *De Socialistische Gids* 6, 1921, pp. 969-985, pp. 980-981.

Dutch science. Interest in the theory of relativity gradually waned as the idea spread that Einstein had not tried to revolutionize human thought. Furthermore, relativity turned out to be accessible only to a very small elite of theoretical physicists. Nonetheless, Einstein remained a public figure, and coverage on his personal doings continued.

Like scientists in the previous chapter, Einstein and relativity were thus especially valued for their contribution to 'culture', whether that would be enhancement of national prestige because of a leading scientific position or new insights on philosophical debates. The new physics was related easily to modernist art, and the incomprehensibility of the theory became a metaphor for specialization and professionalization of society and science. Scientists clearly remained important figures in Dutch society after the war. However, the scale of public reactions and the way in which the responded to Einstein after 1919, were incomparable to the reception of relativity and representation of scientists in the media before that. This can partly be explained by the way in which relativity was popularized, combined with the sudden appearance of Einstein as an international hero after the British eclipse expedition.

Another important factor, however, was probably the "modernization" of Dutch media in general after the First World War. As is described by Huub Wijfjes, the American novelist Upton Sinclair, in a comparison between the Dutch and American press in the early 1910s, had described Dutch reporters as "cultured and understanding" and their reports as "correct and dignified".[258] After the war, modernization of the press had however been unavoidable, also in the Netherlands. From the 1920s on, the Dutch press started emphasizing 'news' and, echoing their American colleagues, were more inclined to publish spectacular stories and to report on celebrities.[259] The furore around Einstein and relativity both fits well with and exemplifies this picture. Yet another reason for the developments in science coverage in newspapers is proposed by Peter Bowler in his work on popular science in the Britain. Bowler, who also points to "an increasing focus on sensationalism" in general,[260] argues that, in Britain, changes in science coverage were partly due to increasing professionalism ans specialization within science. These developments made it much harder for the average reader to actually understand what was going on in science, which was another incentive to shift coverage to more sensational issues.[261]

Leiden politics: scientific internationalism

In the previous section, we have seen that in the Dutch press, Einstein became related to all sorts of issues, especially 'modernist' ones. These issues ranged from socialism and Dadaism to modern physics, relativism, and the Zionist cause. Such connections were of course not particular to the Netherlands, as Einstein soon came to exemplify modern science worldwide. The exact issues relativity and its creator could be related to metaphorically of course differed from country to country. Although his image was determined by cultural differences, Einstein would nonetheless become an icon for science and cultural change in the Western world as a whole. In Britain for instance, Einstein's relativity and the loss of absolute Newtonian space and time it entailed, were frequently related to the overturn of established sex and class relations caused by the First World War.[262] The rest of this chapter will focus explicitly on those factors that were in fact particular to the Dutch reception of Einstein and relativity. One of my aims here is to explain the relatively positive reception of relativity in Holland. The most notable

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[258] Wijfjes, *Journalistiek*, in particular p. 146.
[259] *Ibid*.
[260] Bowler, *Science for All*, p. 196.
[261] *Ibid*., in particular p. 9.
[262] Price, *Loving faster than light*.

particularity of the Dutch reception was of course Einstein's relation with the Leiden physicists, and I will start out with that.

The question why Einstein was appointed in Leiden does not seem important to address: Einstein was on his way to become the world's foremost scientist, and therefore, his appointment in Leiden would of course yield prestige in all quarters. The status of Dutch science would be enhanced abroad; the university of Leiden would gain an advantage over its rivals in Delft and Amsterdam; and appointing the world's most famous scientist at Leiden University would undoubtedly boost the status of science among the Dutch public. As however already pointed out by Jeroen van Dongen, there were also clear political arguments for Einstein's call to Leiden. As already shortly discussed, many scientists of the Royal Dutch Academy, including Lorentz, were actively involved in normalizing international scientific relations after World War I. Einstein, being a democrat and a pacifist, was an excellent ally in this project. This can also be seen from the previously cited letter of Paul Ehrenfest to Einstein of December 1919, in which Ehrenfest let Einstein know that he thought Einstein coming to Leiden would be an enormous contribution to international reconciliation.[263] Even though Einstein was of course first and foremost appointed for his physics, his appointment in Leiden can certainly be considered as an attempt to improve international relations too.[264]

Two figures of central importance in Einstein's appointment were Lorentz and Cornelis van Vollenhoven. The intimate relation between Lorentz and Einstein does not need further explanation; Lorentz was a close friend of Einstein and offered the position to him in person. Van Vollenhoven on the other hand was a board member of the Leiden University Fund that would support Einstein's professorship financially. Furthermore, Van Vollenhoven personally approached the Queen of Holland – who had to ratify the appointment – after Leiden University had approved of Einstein's appointment, and would remain responsible for taking care of the details of Einstein's chair.[265] Lorentz and Van Vollenhoven were both main players in the Dutch attempts at scientific reconciliation after the war, which were fuelled by the Academy of Sciences. Actually, Lorentz and Van Vollenhoven were both key figures in the Academy: Lorentz was secretary of the department of natural sciences; Van Vollenhoven held the same position at the department of arts. Both had defended their ideals on scientific internationalism before, during, as well as after the First World War, and, together, they guided the Academy's normalization attempts in the early 1920s.[266]

Lorentz had promoted science as instrumental for international peace for instance already in 1913, while Van Vollenhoven, a professor of international law, published influential addresses in 1910 and 1913 on the necessity of international peace forces, and played an influential role in debates on Dutch foreign politics.[267] Already during the war, Lorentz had acted as international mediator between scientists from Central Power and Allied countries. He for instance had tried to calm his French colleagues after the Manifesto of 93 in 1914, which had claimed that the Germans were not guilty of war crimes, and stated in particular that the destruction of the library of the Belgian university of Louvain was not such a crime. The Manifesto was signed by many of Germany's foremost scientists and scholars. For many of their Allied adversaries, this showed that there was something terribly wrong with Germany and German culture. For instance the French physicist Marcel Brillouin reacted furiously, and had

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[263] Ehrenfest to Einstein, December 9, 1919, in Kormos Buchwald et. al., *Collected Papers 9*, pp. 286-289. Cited in Van Dongen, "Mistaken Identity", p. 131.
[264] Van Dongen, "Mistaken Identity", in particular pp. 130-134.
[265] *Ibid*., pp. 134-142.
[266] Otterspeer & Schuller tot Peursum-Meijer, *Wetenschap en wereldvrede*.
[267] Corduwener, "Risee". Van Vollenhoven published his "Roeping" in 1910 in *De Gids*, and a collection of articles as *Eendracht* in 1913.

already *before* the Manifesto asserted to Lorentz that he no longer considered German scientists his colleagues, notably "with the possible exception of Einstein".[268] During the war, Lorentz tried to re-establish relations between scientists on both sides. He pointed out to the French and Belgians that there were some Germans scientists that in fact regretted German actions, and that many subscribers were remorseful about their role in the Manifesto. At the same time, Lorentz of course insisted to his German colleagues that they *should* regret those German actions, and presented actual evidence of German war crimes to them.[269]

When new international scientific associations were created after the war, most notably the *International Research Council* (IRC), scientists from Central Power countries were initially excluded from membership. Due to the Manifesto of the 93, which was of course widely met with outrage in Allied countries, Belgian and French academics considered their German counterparts accountable for Germany's war crimes. As described by historians Otterspeer and Schuller tot Peursum-Meijer, the Dutch Academy of Sciences joined the IRC, but only on the condition that they could maintain their ties with scientists of the excluded countries. At the same time, reuniting scientific communities of excluded countries with the IRC immediately became an important issue for Dutch science after their accession to the IRC.[270]

Einstein certainly supported the idea of international scientific collaboration at which Van Vollenhoven and Lorentz were aiming; presumably, Van Vollenhoven and Lorentz considered Einstein's appointment helpful for their cause. That, however, did not mean that they held the same thoughts on internationalism. Although Einstein had ideas on international peace forces that were similar to those of Van Vollenhoven, the two scholars had different aims. Einstein vigorously supported a 'true' internationalism, as did Ehrenfest for that matter. Einstein was a German-born Jew, who had renounced his German citizenship, had been naturalized to a Swiss and had later accepted German citizenship again in order to secure a position in Berlin; Einstein was both a German and a Swiss until he would renounce his German nationality a second time in protest to the events of 1933. Ehrenfest was born an Austrian Jew and had begun his career in Germany and Russia, but had become a Dutch citizen in 1922. Necessarily, Ehrenfest and Einstein would not subscribe to strong nationalist ideas, and their internationalist ideals aimed at the organization of peace on a level *transcending* nationalities.[271] The scientific internationalism advocated by Lorentz and Van Vollenhoven was, of course, also related to considerations on the ethical tasks and selflessness of science. Another of their main goals, however, was to specifically enhance the position of the Netherlands and its science internationally. Presenting themselves as peace brokers was not only the right choice ethically; it was also a means to increase the prestige of their beloved country.[272] Their internationalism was therefore essentially also a disguised form of nationalism.

Interestingly, in Britain too, internationalist motives played an important role in the early popularization of relativity theory. The early popularization in Britain was largely a one-man effort carried out by Eddington. Eddington too acted strongly on his pacifist ideals. In 1916, Eddington wrote to De Sitter, one of his main contacts in continental astronomy, that he was "interested to hear that so fine a thinker as Einstein is anti-Prussian."[273] Both his appreciation for relativity and his wish to restore internationalism to science were powerful incentives for Eddington to popularize the theory in Britain. As a member of the Quakers, a Christian

[268] Brillouin to Lorentz, September 12, 1914. Cited in Bertrams, "Caught-up by Politics", p. 147.
[269] Bertrams, "Caught-up by Politics", pp. 146-149.
[270] Otterspeer & Schuller tot Peursum-Meijer, *Wetenschap en wereldvrede*.
[271] On the differences between the internationalist ideas of Lorentz and Ehrenfest, see Van Lunteren, "Wissenschaft internationalisieren".
[272] Otterspeer & Schuller tot Peursum-Meijer, *Wetenschap en wereldvrede*.
[273] Eddington to De Sitter, October 13, 1916, cited in Stanley, "Expedition", p. 69.

movement which advocated pacifism and tolerance as opposed to violence and dogmatism,[274] Eddington's internationalist outlook was much closer to that of Einstein than to that of Lorentz and Van Vollenhoven. Eddington was however much less successful in popularizing relativity than Dutch physicists had been. Although the main reason for that was probably the significance of anti-German sentiments in Britain, the unorthodoxy of Eddington's pacifism, in the sense that it did not comply with nationalist ideas, might have been another factor in Eddington's less successful popularization. In any case, in Leiden, Einstein's appointment was certainly facilitated by his political ideas. In order to relate this to the reception of relativity, the question now needs to be addressed how internationalism was perceived in Dutch public opinion.

Einstein and the internationalist perspective in public opinion

As we have seen, the public was kept up to date on Einstein's appointment in Leiden, and the way in which anti-Semitic attacks on Einstein were condemned by Dutch media already provided a first glance on the political coverage on Einstein. The picture of the selfless scientist wronged by small-minded nationalists was soon firmly established in the Dutch press. Already in February 1920, the *Handelsblad* for instance covered a decoration of Einstein by the British Royal Society, which had been impending since the events in November. The newspaper had corrected itself for reporting wrongly that Einstein had already received the Society's gold medal, a message that "everyone would have cheered as a sign that the psychosis of war, at least in the scientific world, begins to diminish".[275] The Royal Society however now retracted its medal, according to the *Handelsblad* because the Society had found out that they had mistakenly considered Einstein as a Swiss, where he in fact was a German citizen. As just explained, in reality, Einstein was of course both a German and a Swiss. As we have already seen, the Catholic newspaper *De Tijd* copied this report, under the self-explaining header "narrow-mindedness?"[276]

At that very same day, *Het Vaderland* reported on the disturbance of Einstein's lecture. *Het Vaderland* blamed these disturbances on right-wing students that protested Einstein's political affiliations. The *Handelsblad* gave a more complete coverage on that affair. It clearly explained that the main reason behind the protests was Einstein's admission policy: Einstein favoured a broad audience, and allowed anybody in, which of course resulted in overcrowded classrooms.[277] Reactionairy students in fact had disturbed lectures of several pacifist professors, but in Einstein's case, this was not the main motive of student protests.[278] Nevertheless, in all these articles in the Dutch press, Einstein was portrayed as victim of nationalist tendencies. Reports on Einstein's active involvement with internationalism, however, would not become prominent for some time, although several of the newspapers involved referred to his alleged political sympathies with 'the far-left'. Einstein himself was not yet seen as a mediator, even though a favourable reception of relativity theory in Britain was in fact considered as an indication of normalization of international relations.

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[274] Stanley, "Expedition".
[275] *Handelsblad*, February 14, 1920, p. 1, "Geen medaille voor Einstein": "Dit bericht, dat ieder met vreugde zal hebben begroet als een teeken, dat de oorlogspsychose althans in de wetenschappelijke wereld begint af te nemen, blijkt […] niet geheel juist te zijn."
[276] *De Tijd*, February 14, 1920, p. 1, "Kleingeestigheid?".
[277] *Het Vaderland*, February 14, 1920, p. 3, "Een voorlezing van Einstein verhinderd". *Handelsblad*, February 14, 1920, p. 6, "Studenten en politiek".
[278] Van Dongen, "Mistaken Identity", p. 135.

The most intense expression of anti-Semitism and politically based attacks in general on Einstein took place during August and September 1920.[279] Paul Weyland, an obscure right-wing propagandist, organized a meeting at the Berlin Philharmonic where he himself portrayed Einstein as a fraud and relativity as a fantasy. According to Weyland, the success of relativity was largely due to propaganda and a conspiracy between Jewish physicists and media. Weyland drew on criticism of Nobel-laureate and experimental physicist Philipp Lenard, while Ernst Gehrcke, another experimentalist and long-time opponent of relativity, was the second speaker at Weyland's widely advertised and well attended anti-relativist assembly. The opposition of Lenard and Gehrcke to relativity theory was mainly a reaction to the new, highly mathematized theoretical physics which in their opinion could not lead to a true understanding of nature. Both objected the removal of the ether and referred to various other explanations in order to explain specific effects of relativity theory. Gehrcke for instance referred to classical calculations on both light deflection and the anomalous movement of Mercury already in 1916, when general relativity had just been published. Nonetheless, Gehrcke also became a, if not the, central figure in the politicized anti-relativity movement. He corresponded with as many opponents of Einstein's work as he could find, and dismissed differences among these anti-relativist in favour of their mutual disagreement with relativity – even if the anti-relativists formed a highly heterogeneous group, including physicists, engineers, teachers, philosophers and physicians. Important to Gehrcke was that the opposition against Einstein would be united.[280]

In particular the episode around the assembly at the Berlin Philharmonic received much attention in the Dutch press. The first reaction came two days after the assembly, on 26 August, when the *Handelsblad* placed the resistance to relativity in a long tradition of conservative opposition to new theories.[281] Einstein himself however, saw things differently. On August 27, he reacted in the *Berliner Tagblatt*,[282] stating that although his opponents were not worthy of his response, he wished to react because he had good reasons to believe that his adversaries had other – that is political – motives for their attack on relativity. In the Netherlands, especially liberal newspapers reacted to the situation over the next few days. They summarized Einstein's response; reported that he considered leaving Berlin; quoted from further coverage in the *Berliner Tagblatt*, which condemned the scene as a disgrace for the city of Berlin and German culture; and reported that Einstein received widespread support in Germany itself. In all these Dutch responses, it was clear that Einstein had become a victim of anti-Semitism.[283] The *Nieuw Israëlietisch Weekblad* even felt that this particular incident, an anti-Semitic attack on Einstein, was among the most important of the week,[284] while the socialist *Het Volk* opened that same day with a counterattack on German anti-Semitism and the responsible "representatives of the old lineages". The enemies of Einstein were the same as the enemies of socialism, as what they hated most was progressiveness. *Het Volk* however welcomed Einstein, their "fellow citizen in the endless realm of thought".[285]

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[279] See e.g. Van Dongen, "Reactionaries and Einstein's Fame" and Goenner, "Reaction to Relativity", for detailed accounts on these events.
[280] See Wazeck, *Einsteins Gegner*, for a discussion of the anti-relativity movement. An attempt to explain the origins and dynamics of the controversy around relativity is Wazeck, "Marginalization processes".
[281] *Handelsblad*, August 26, 1920, p. 10, "Miskende genieën".
[282] Einstein, "Meine Antwort".
[283] For instance: *NRC*, August 27, 1920, p. 10, "Prof. dr. Einstein"; *Handelsblad*, August 28, 1920, p. 9, "Einstein wil Berlijn verlaten"; *Het Vaderland*, August 29, 1920, p. 3, "Albert Einstein"; *Handelsblad*, August 31, 1920, p. 1, "Professor Einstein"; *NRC*, September 1, 1920, p. 3, "Einstein"; P.G. van Slochteren, "Een groot oriëntalist op zijn smalst", *De Groene Amsterdammer*, January 15, 1921, p. 4.
[284] *Nieuw Israëlietisch Weekblad*, September 3, 1920, p. 1, "Belangrijkste feiten van de week".
[285] *Het Volk*, September 3, 1920, p. 1, "Broederschap".

The fact that several liberal, Jewish and socialist journals condemned anti-Semitism, was not particular to the Dutch reception of Einstein: for instance their liberal colleagues in German and France also heavily criticized right-wing reactionaries. The main difference between the Netherlands and its neighbours, however, was that no such reactionary and conservative reactions existed at all in Dutch media. Where in Germany and France, the liberal press had to react to reactionary critics on their own country, Dutch newspapers were unanimously outraged by the Weyland-events. The Dutch reacted on those French and German attacks too. They portrayed Einstein as a victim of nationalist, reactionary politics and pseudo-scientific criticism. Right-wing attacks were thus absent in the Netherlands, and reading the newspapers, one senses their pride that while madness had struck in Germany, Holland and its inhabitants had remained reasonable and reacted objectively and rationally to Einstein and relativity.

Such moral presumptions actually fitted in well with the role the Dutch had tried to acquire for themselves during the war. In the later half of the nineteenth century, Dutch foreign policies had been based on self-preservation, and have often been described as policies of non-involvement and restraint.[286] Historian Pepijn Corduwener has however shown that around the turn of the century, the idea that a neutral attitude was desirable especially on moral grounds gained significance in public opinion. Instrumental for the development of the Dutch self-image and the idea of moral superiority on basis of neutrality, had been the international peace conferences in The Hague, held in 1899 and 1907, and the subsequent establishment of the Peace Palace.[287] Where around 1900 anxiety had grown among the Dutch elite about the future place of their nation, Cornelis van Vollenhoven himself had persuasively argued that the Netherlands could attain new international significance by a stance that aimed at international law and peacekeeping,[288] in the 'tradition' of the famous Dutch Golden Age philosopher and legal scholar Hugo Grotius. Although Van Vollenhoven's specific ideas on international peace forces and the supposed leading role of the Netherlands in those, legitimated by Van Vollenhoven via the "minor ambitions" to power of the Dutch state and its history of neutrality, were in fact not supported widely, the idea that the Netherlands were suited for a leading role in international peacekeeping did gain significance. Consequently, neutrality and internationalism became part of the "national identity".[289]

During the planning of a third international peace conference in The Hague, the First World War broke out. According to Dutch public opinion, the war was unjustified en nonsensical. The Dutch, as bystanders, considered themselves still civilized, rational and peaceful, while in neighbouring countries, rational thought had been impaired by nationalistic sentiments. Because of that, the Dutch considered themselves to be neutral arbitrators and impartial judges. This attitude however changed during the war. Initially, neutral parties had indeed been considered as the objective judges of the war. Later on, however, especially the British would claim that they themselves were the protectors of justice, while the neutrals were seen as 'weaklings' and their attitude as 'spineless'. Due to this international debate, in Dutch public opinion the emphasis shifted from neutrality and justice to independence and mediation. Near the end of the war, the Dutch became even less involved with international politics, and focused on the post-war perspectives of their country.[290]

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[286] See e.g. Voorhoeve, *Peace, profits and principles*, Van Diepen, *Voor Volkenbond*.
[287] Corduwener, "Risee". As the fact that these peace-initiatives took place in the Hague already indicates, the Netherlands were probably among the first to embrace this 'moral neutrality'. Lettevall, Somsen & Widmalm claim that the First World War "saw the beginning of the moralization of neutrality", see "Introduction", p. 8.
[288] Van Vollenhoven, "Roeping".
[289] Corduwener, "Risee".
[290] Tames, *Oorlog*, in particular p. 254.

Non-involvement and neutrality however remained widely favoured in the Netherlands. Historian Piet de Rooij has pointed to the fact that during the war, society as a whole had subordinated itself to the preservation of neutrality.[291] After the war, feelings of moral superiority still prevailed in the Netherlands. In comparison to its greater neighbours, where public opinion was still dominated by war rhetoric, the Dutch felt that they themselves were most sensible, and in an excellent position to mediate between the former enemies. This would particularly be the case because of their ideal position between the British, French and German. Not only geographical, but also in character the Dutch stood in-between their neighbours: the 'national character' of the Dutch formed a 'synthesis' of German, French and British characters. This 'characteristic identity' of the Dutch was not simply a mixture of that of its neighbours: the Dutch argued that it was a balanced composition. Historian Ismee Tames has argued that these ideas on the favourable Dutch national characteristics were related to the pluralistic character of Dutch society. The Pacificatie of 1917 was exactly the kind of compromise that the Dutch also considered the best resolution of the Great War. Instead of a victory for one of the warring sides, the Dutch, in order to maintain their position in international politics, needed an agreement which would keep the balance of power between their neighbours intact.[292]

The Treaty of Versailles was therefore not received well in the Netherlands, not only because Germany alone was held accountable for the war – the Dutch considered Allied countries responsible as well – but also because the pressure the Treaty exerted on Germany would damage the Dutch economy. According to the Netherlands, the former belligerent countries would do well to attain a more stable peace settlement.[293] Nonetheless, Holland did in fact join the newly formed League of Nations, the organization set up by Allied countries that purported to prevent further wars. As it did exclude Germany, and, according to many in the Netherlands, favoured policies of power over those of justice, the League of Nations gained little support in Dutch public opinion. The Dutch however still considered joining the League of Nations less harmful than staying aloof, as the idea of becoming an international peace broker again was widely supported. That was of course especially the case after that prospect had been enforced with the establishment of the Permanent Court of International Justice in The Hague in 1922.[294]

Thus, the Dutch outrage over reactionary attacks on Albert Einstein was clearly related to their 'moral superiority' and the ideas of neutrality and rationality defined around the war. Not only did the Dutch consider themselves to be neutral and rational. Personal attacks on Einstein were seen as contemptible also because science, too, as a supposed value-free enterprise, was often considered in terms of objectiveness and neutrality.[295] Illegitimate attacks on science could therefore be considered attacks on the values of the Dutch national identity. An assault on science was an assault on reasonableness: an assault on science was an assault on the Netherlands. Together with his reputation as leading physicist, the sympathy for Einstein created by these reactionary attacks certainly had a positive impact on the reception of relativity.

The fact that, at a certain point, Einstein himself was also portrayed as international mediator did of course further boost his image. This picture of Einstein emerged around mid 1921. When Einstein for instance visited Britain in 1921, a stop on his American fund-raising

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[291] See de Rooij's preface in Abbenhuis, *Staying Neutral*.
[292] Tames, *Oorlog*, p. 264.
[293] Van Diepen, *Voor Volkenbond*, pp. 40-42.
[294] *Ibid.*, pp. 53-61.
[295] For a discussion of the associations of science and neutrality around the First World War, see for instance Lettevall, Somsen & Widmalm, "Introduction", Schroeder-Gudenhus, "Probing the Master Narrative".

trip for the Hebrew University, one of his lectures became a main element in an extended article in *Het Vaderland*. The reporter discussed general life in England, two of his main lines being the vanity of the British elite and the coalminers' strike. The latter was fuelled by a decrease in salaries in Britain, a consequence of post-war refinances. Although the reporter wondered whether peace could be attained in British industry, and whether peace in general was a dream, he affirmed that at least in science it was not an illusion, as a recent lecture of Einstein at King's College indicated. His British audience had received Einstein with genuine enthusiasm, even if he lectured in German. The reporter considered Einstein's lecture as a "true attempt to bury the past and to open at least in science the borders for scholars of any nation and any train of thought".[296] Indeed, Einstein had, in general, received a warm welcome in England, although British public opinion had mainly considered him a source of entertainment and the English had taken relativity theory even less seriously than the Dutch public.[297]

Einstein further expanded his image as scientific diplomat in the years hereafter. His international trips certainly contributed to that image. When Einstein for instance was nominated as a corresponding member of the French Academy of Sciences in 1921, Dutch media wondered whether that had to be understood as an attempt at reconciliation between French scholars and "their German colleagues who had not signed the Manifesto of 93".[298] Of course, this was the case: Einstein had been invited shortly after he had declared in a French interview that Germany was to be blamed for the war. When Einstein eventually visited Paris in 1922, a trip that was certainly meant to reconcile the German and French scientific communities,[299] newspapers in Holland *en masse* reported that Einstein was very happy with French willingness to both revive intellectual relations between France and Germany and to solve the "big issues of Europe".[300] Einstein thus emerged from these stories as an internationalist and pacifist, epitomizing many of the values of the Dutch 'national identity'. Only a month after his visit to Paris, Einstein even acquired an actual political function. In order to reconcile the international scientific community, as he had already discussed with Lorentz, Einstein was offered a seat in the League of Nation's committee on "international intellectual cooperation", which again spurred extensive coverage in the Netherlands.[301]

Einstein's membership of this *International Committee of Intellectual Cooperation* (ICIC) was however not very successful. As some of the details of Einstein career in this committee disclose detailed information on the relation between Einstein and Lorentz, and Einstein's own ideas on the authority of scientific knowledge, a short interlude might be helpful here. The first president of the ICIC was the French philosopher Henri Bergson, who has been called the "single most politically committed intellectual of his time".[302] Bergson disagreed with Einstein on many issues, notably, also on the correct interpretation of relativity theory. Bergson argued, just as

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[296] *Het Vaderland*, June 22, 1921, p. 5, "Zomer in en buiten Londen".
[297] On the British reception of Einstein in 1921, see Stanley, "Expedition", p. 87, Price, *Loving faster than light*, pp. 34-41 and references therein.
[298] *NRC*, November 3, 1921, p. 2, "Wetenschappelijke berichten".
[299] On Einstein's relations with the French scientific community and his trip to Paris, see Biezunski, "Einstein's Reception", Van Kimmenade, *Resistance*.
[300] See e.g *Het Vaderland*, April 10, 1922, p. 2, "Einstein over den internationale toestand"; *Rotterdamsch Nieuwsblad*, April 11, 1922, p. 1, "Allerlei".
[301] For instance: *Rotterdamsch Nieuwsblad* p. 1, "De Volkenbondsraad" and *NRC* p. 5, "Duitschland", on May 16, 1922, reports on Einstein's election as a member of the council for intellectual cooperation; *Het Vaderland* June 10, 1922, p. 2, "Einstein en de Volkenbond", Einstein informed the League that he would accept the position, although he did not understand what the exact nature of his work would be; *NRC* October 3, 1922, p. 5, "De derde Volkenbondsveragdering"; A report on the meeting of the League of Nations, with fair attention to Einstein and his commission.
[302] Canales, "Einstein, Bergson", p. 1173.

Lorentz had done on numerous occasions, that relativity did not necessarily entail a true revision of the fundamental concept of time. According to Bergson, Einstein had only revolutionized *physical* time: the philosophical notion of absolute time was not in any way jeopardized by Einstein's work. Einstein and Bergson publicly debated these issues, and Einstein reacted sharply to Bergson's arguments. Einstein's main claim was simply that Bergson had misunderstood relativity.

Einstein and Bergson also disagreed on the position and future of their committee. From the very beginning, Einstein was concerned that the committee did not act on a genuine internationalism, as it was dominated by French intellectuals, many of whom supported anti-German ideas.[303] In the committee, Einstein tried to establish *his* form of internationalism over more nationalistic views on international collaboration, but did so unsuccessfully. As Einstein also felt that he, as a Jew and anti-chauvinist, could not truly represent Germany's intellectuals, he resigned his position already in 1923. Historian Jimena Canales has argues that Einstein's resignation was related to Bergson's critique of relativity, as Einstein by 1923 would consider all criticism on relativity politically motivated. Although that might be a bit exaggerated, it seems evident that personal quarrels between members would not serve the ICIC well. Einstein's position in the committee was taken over by Lorentz, who in 1925 also succeeded Bergson as president after the latter's resignation. Einstein had already rejoined in 1924, but would never put much effort in the committee.[304]

Although the ideas Lorentz and Bergson held on the interpretation of relativity theory were related, Einstein reacted very differently to them. One of the reasons for that was of course that Lorentz, as a physicist, had formulated his ideas in a much more nuanced way than Bergson had done. A second reason was the close friendship between Lorentz and Einstein. But, as Canales has argued, there were other issues involved: Einstein's response to Bergson was ultimately about the issue of the role of science in relation to philosophy. Where Einstein would argue that philosophy only came into play where scientific reasoning was insufficient, Bergson claimed that philosophy and physics were at the same level. For Bergson, this meant that there could be different notions of time for physics and philosophy. Einstein on the other hand argued that philosophy was only intended to *interpret* his physical time,[305] and thus, that there could be no contradiction between philosophy and physics.

As will become clear in the next chapter, the exact same issues played a role in the Dutch popular reception of relativity theory. This is not very surprising, as not only Lorentz, but also for instance Van der Waals jr. criticized Einstein's revision of time in a way that was similar to Bergson's critique. The fact that Einstein did not publicly engage in debate with fellow theoreticians on these issues indicates that his attack on Bergson was largely motivated by issues of competence. Presumably, Einstein felt that the likes of Bergson were not qualified to engage in a debate that, according to Einstein, was strictly within theoretical physics. Most likely, Einstein would rather have had this debate settled in personal correspondence or in other informal discussions. Einstein clearly felt that, Bergson, as a dilettante, would only confuse his public, and was therefore best kept out of these scientific discussions, and especially public discussion.

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[303] *Ibid*., p. 1174.
[304] *Ibid*. See also Canales, "Twins and Time".
[305] *Ibid*.

Explaining the positive reception

Einstein's relation with the Netherlands, as well as his – from a Dutch point of view – favourable political ideals were certainly helpful in his positive reception in the Netherlands. That these factors became visible in the Netherlands early on, was of course mainly due to Einstein's contact with Leiden physicists. Lorentz, Ehrenfest, and the group around them acknowledged Einstein's leading role in theoretical physics, while at the same time, Einstein's fame would of course give significant status to their own work on relativity. Intermediation and self-preservation had not only become key in Dutch national identity, these terms were also directly applicable to the stance of Dutch scientists on relativity: the Dutch were of great importance for the dissemination of relativity, while at the same time, Einstein's theory of relativity increased the prestige of especially Lorentz' earlier scientific work. Meanwhile, as we have seen throughout this thesis, public interest in science was growing. This was not only se because of the institutional changes in the Dutch educational system which allowed the lower classes to come in touch with scientific knowledge; it was also as a consequence of the extensive popularization of science, which in part resulted from a felt undervaluation of fundamental research after the war. Much of the *interest* in relativity can therefore be explained by changes in the position of science in general. The fact that the Dutch reception was relatively positive, was on the other hand largely due to Einstein's relation with Dutch science, his political views, and a favourable scientific climate in which scientists held much allure.

That Einstein himself, in an interview on his return from his 1921 America trip, declared that "his love for Holland was endless",[306] of course did not damage his reputation in the Netherlands either. This particular interview in the *NRC* would become quite famous, not in the least because Einstein would a couple of days later distance himself from parts of the text. Einstein claimed that he had not known that the conversation would be published, and that the reporter had written the interview from memory, which meant that the words in the text could not correspond exactly to what he had said. The main problem with the Dutch text was that it had Einstein comment extensively on the extravagance of the Americans and the fact that they were bored so much that anything as remotely interesting as relativity could create mass-reactions.[307] This of course would not have been very important for the average Dutch reader; more striking would have been Einstein's confession in the *NRC* that he did not really like "performing" for the masses, but would do so for the right cause. This, of course, would only confirm his role as a diplomat of rationality, objective science, and internationalism again.

That such expressions were received well in the Netherlands should by now be evident; that the Dutch used their ties to Einstein to boost their national pride as mediators does not have to surprise us either. A clear-cut example of Dutch exploitation of Einstein's reputation appeared in the *NRC* in November 1921, with the suggestive title "Leiden as international scientific centre", while similar articles appeared in the *Handelsblad* and *Het Vaderland*. These newspapers reported that Einstein's recent visit to Leiden had been the occasion of an international meeting, where besides Einstein and several Dutch scientists, also the professors Langevin from Paris, Weiss from Strasbourg, and Jeans from London had been present, as the group had prepared itself for the upcoming Solvay meeting.[308]

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[306] *NRC*, July 4, 1921, pp. 5-6, "Een interview met prof. Albert Einstein".
[307] Rowe & Schulmann, *Einstein on politics*, pp. 111-113.
[308] *NRC*, November 14, 1921, p. 4, "Leiden als internationaal wetenschappelijk centrum". See also *Handelsblad*, November 15, 1921, p. 7, "Leiden als internationaal wetenschappelijk centrum", and *Het Vaderland*, November 15, 1921, p. 6, "Wetenschappelijke betrekkingen". On Dutch exploitations of Einstein's international image, see Van Dongen, "Mistaken Identity" and Van Besouw & Van Dongen, "Reception of relativity".

As science itself was seen as a cultural enterprise, science and attempts at pacification became intermingled. The self-image of moral superiority the Dutch had created during the war was easily identifiable with the image of the selfless, objective, and detached scientist. Dutch scientists, a group whereto Einstein at times almost seemed to belong, could therefore be seen as ambassadors of their nation, even more so because eminent scholar such as Lorentz and Van Vollenhoven were actively involved in international reconciliation. Something similar actually happened in Weimar Germany in the 1920s, where scientists used the supposed internationalism of science in combination with the high status of their own science to boost national prestige. These scientists considered themselves the true diplomats of the German nation. By combining the internationalist and selfless conceptions of science, they tried to enhance both the prestige of science on a national level, and the status of their country internationally.[309] At the same time, we have seen that Einstein, who did not share German nationalism in that sense, was at least in the Netherlands considered as a spokesperson of Germany and its science. The Germans did use Einstein in their *Kulturpolitik*,[310] even though the mainstream motives of German scientists were very different from the supranational ideals of Einstein. Similarly, the Dutch saw Einstein as an ally in their quest for scientific reconciliation, even though the Dutch too had nationalist incentives.

The Royal Academy of Sciences' mission, in this context, can best be seen as a continuation of national ideals and politics on a scientific level. The Academy's quest continued throughout the 1920s and early 1930s, and more and more Dutch scientists would become involved. Although the effectiveness of their mediation was questionable, Geert Somsen has remarked that the Dutch never doubted their mission. They kept insisting at internatinional reconciliation, which was considered self-evidently good: the Dutch considered reconciliation a *moral* cause.[311] Einstein's 'cause', although he supported a different kind on internationalism, was certainly 'moral' too, and Einstein supported the direct aims of the Dutch Academy. Einstein admired Dutch internationalism and tolerance, while the Dutch admired Einstein for both his prestige as a physicist and his political ideals. Furthermore, relativity was placed in the distinguished Dutch tradition of electrodynamic research by Lorentz and others. Therefore, both Einstein's politics and science were, by the Dutch, considered to be strongly tied to the Netherlands. Where having Einstein on their side was a promising prospect for the Dutch peace brokers, his relation with Dutch physics and his appointment in Leiden provided an excellent opportunity to strengthen public support for physics. What could possibly enhance public appreciation of science more than the appointment of Albert Einstein himself, after of course the Leiden physicists had put great effort in guaranteeing public interest by active popularization of Einstein's work?

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[309] Forman, "Scientific Internationalism".
[310] *Ibid*., in particular pp. 165-167.
[311] Somsen, "Holland's Calling", p. 57.

6. Relativity in 'intellectual' culture: reactions and employment

After the previous discussion of public images of relativity theory and Einstein and the influence of scientists on public opinion, the 'general' public reception, I will now focus on the reception and use of the theory in 'popular science'. Publications that will be analysed here do not predominantly use relativity as a trope. In this chapter, I will discuss those articles, notes and books that seriously attempted to discuss relativity. What did non-experts do with Einstein's theory of relativity? How did they use it to strengthen or put forward their own ideas? What does that say about their perception of science, and what does the interplay between expert accounts and public responses to science tell us about the role of science and the authority of scientific knowledge? Again, I will discuss each response to relativity individually. Although this might at some points boil down to a rather tedious and repetitional story, this approach has clear benefits, especially in understanding the motives of individual authors. Because of that, this discussion will subsequently facilitate the identification of general trends in the perception of relativity theory. An analysis of these trends will be helpful in appreciating attitudes towards science in general. I will refrain from identifying discussions of Einstein's work as pro- or anti-relativity. Instead, my focus will be on the nuances of reactions to the theory, especially on arguments that support certain assumptions about the role and methods of science.

Here again, my main interest lies with the most influential ideas, not with the most vehement or controversial reactions to relativity theory. Instead of spelling out the most vigorous criticism or defence of relativity, or pointing out all of the misconceptions made by non-specialists, I will try to find common grounds in reactions towards this particular instance of modern science. That does not mean that I will ignore outspoken reactions or misinterpretations: the very fact that someone would have bothered to write down his or hers thoughts on relativity and managed to get those published, is exactly what qualifies a person to be included in this chapter. Noteworthy, although not surprising, almost all of the reactions here come from engineers, philosophers, physicians, and high school teachers, that is, people on the fringes of science. These people all had received significant education in the natural sciences, and were often allowed to publish in journals such as *De Gids*, *Onze Eeuw*, *Vragen van den Dag* and *De Ingenieur*. They could therefore engage in debate with experts, who as we have seen, published popular work in these same journals. As these engineers, philosophers and the like were close to the sciences but not actually part of it, analysing their thoughts on the role of science will be helpful in understanding the relations between science and the public, and especially to understanding contemporary demarcations of those categories.

The experts or professional physicists – we have met most of them already in chapter four – are in this chapter directly involved with the popular reception of relativity. In 'public opinion' on Einstein and relativity, scientists were the *object* of the story: as we have seen, the average journalist would not question the authority of expert physicists. The engineers and philosophers discussed here, however, felt that they in fact did have the competence to negotiate the interpretation and value of relativity theory. Subsequently, physicists felt that their authority on scientific matters hung in the balance. At the same time, the scale of this segment of reactions to relativity is quite limited. Including popular accounts by the experts, the number of Dutch publications that directly addressed the theory of relativity in the period up to 1925, ranges somewhere between one and two hundred. This means that physicists could exercise much more control over the dissemination of popular interpretations of relativity than they could over the general image of Albert Einstein. As we will see, especially Fokker and Van der Waals jr. would in fact react fiercely to those publications that compromised their views or authority.

Much of the reactions that will be studied here have already been discussed in Henk Klomp's PhD dissertation *De Relativiteitstheorie in Nederland: breekijzer voor democratisering in het interbellum*. Klomp makes two central claims in his dissertation.[312] The first is that those who tried to "defend their status and worldviews in a changing society" in general reacted reservedly towards relativity. Klomp defends this point on basis of reactions to relativity from members of both the liberal elite and those of leading figures of several religious denominations, and relates their reactions to Dutch pillarized society. I will come back to this point later. Klomp's second and most important claim, as already expressed in his subtitle, is that relativity theory has made a decisive impact on the democratization of the Netherlands. According to Klomp, relativity, through its influence on debates that concerned reform of especially secondary education, has accelerated the development to a more democratic, that is less totalitarian, form of education. Although it is certainly true that relativity assisted certain people – in particular Philipp Kohnstamm, Adriaan Fokker and Tatiana Ehrenfest-Afanassjewa, Paul Ehrenfest's wife – involved in these debates to overcome arguments of their opponents, I believe that Klomp strongly exaggerates the influence of relativity. The role Einstein's theory played in Dutch educational reform was actually quite moderate. It provided the likes of Kohnstamm with some arguments against the deductive-axiomatic method of teaching mathematics that was advocated by the influential high school teacher and historian of science E.J. Dijksterhuis. These arguments were however far from decisive: educational reform was only realized after the Second World War. Besides that, as discussed in chapter two, the Netherlands were already democratizing before the debates described by Klomp actually took off. Political forces were, of course, much more important in that process than any arguments that might be derived from the theory of relativity.

As all this has been discussed elsewhere,[313] I will not go into detail on Klomp's central thesis here. The debate on educational reform for a large part took place in the late 1920s and 1930s, and is therefore out of the scope of this thesis. The furore about relativity had already abated by then, and discussions on its influence 'outside of physics' had largely faded out. Nonetheless, I think it might be helpful to give a brief outline of the debates described by Klomp, as many of those involved in the debates on education did in fact react to relativity theory. Although I would not claim that debates on educational reform and discussions on the correct interpretation of relativity were interdependent, they certainly influenced each other, as both debates drew in the same intellectual and philosophical discussions. These discussions are vital for a sound understanding of the reception of relativity; therefore, an introduction is necessary.

Determinism, educational reform and relativity

As we have seen, relativity became involved in discussion on modern science and philosophy quickly. Most scientists were reluctant to use relativity to make claims on a metaphysical level. However, two main protagonists in Klomp's account were not. Fokker and Kohnstamm, brothers in law, from the 1920s on tried to interpret relativity in such a way that they could use it to counter deterministic worldviews. Fokker did not criticize determinism as such, but supported an idiosyncratic holistic conception of space and time, in which concepts such as causality and determinism lost most of their relevance. However, refuting 'strong determinism' was a main objective for Fokker, as it was for Kohnstamm. Historians have linked their disapproval of

[312] Klomp, *De Relativiteitstheorie*, pp. 2-3.
[313] Klomp's work is discussed in detail in Van Lunteren, "Natuurkunde en Democratie" and Van Besouw & Van Dongen, "Reception of relativity". Others have commented on Klomp's theses too, see e.g. De Jong & Van Lunteren, "Fokkers Greep"; Baneke, *Synthetisch Denken*.

determinism to a resistance towards materialism and an inclination for a 'moral responsible' science. Especially for Kohnstamm, relativity seemed to promise freedom from the bonds of determinism.[314] This freedom was apparently even more important than a correct interpretation of relativity theory for him: Kohnstamm – who was *not* an expert on relativity – in the 1920s argued that the theory supported indeterminism, and thereby ignored criticism on this point by his friend Paul Ehrenfest.[315]

Discussions on the meaning of causality and determinism played an important role in Dutch scientific culture around the turn of the century. This was primarily a reaction to nineteenth century science, which was considered to be exaggeratedly aimed at rationality. Positivist claims that science would lead to social progress, combined with the fact that science and technology did not incorporate intuition and creativity, gave rise to the *bankruptcy of science* debate in Western Europe around 1900. Critics claimed that science had become too materialistic and that its far-reaching conclusions on metaphysics were not sustainable. In the nineteenth century, science had in the intellectual debate been considered the basis of a new worldview, but such positivist and modernist views were now strongly contested. Although, as described by David Baneke, this debate was in the Netherlands far less severe than it had been in other countries (note the similarities with the reception of relativity), it did affect Dutch intellectual culture in the first decades of the twentieth century.[316]

After the Great War, discussions on the role and impact of science became intermingled with the educational debates discussed by Klomp. Questions on the status of free will and the possibility of a rational worldview played an important role in proposals for educational reform. Especially scientists such as Kohnstamm and the biologist H.J. Jordan argued on basis of such ideas that students should not be educated in a dictatorial manner. Instead, the goal of education should be too stimulate students to become capable, civilized, and synthetic thinkers themselves (although this pertained especially secondary education, such thoughts are of course closely related to the debates on 'general formation' at the universities touched upon in chapter two). Jordan considered educational reform as the most direct way to influence society as a whole.[317] The organization of society was also Kohnstamm's main interest: Kohnstamm was an outspoken democrat – he had in fact been chairman of the social-democratic *Vrijzinnig Democratische Bond* when it helped to achieve universal suffrage in 1917 – and believed that even those who had not profited from higher education could make sound judgments on political issues. The best way to increase the effectiveness of democracy was therefore to prepare as many citizens as possible for their responsibilities.[318]

Although ideas that concerned the 'formation of civilized thinkers' influenced educational debates in general, arguments derived from relativity theory particularly played a role in debates on mathematics education. As discussed by Klomp, the main advocate of the contemporary 'conservative' method in mathematics education was Dijksterhuis. Historian of science and high school mathematics teacher himself, Dijksterhuis believed that a rigorous training in Euclidean deductive-axiomatic methods was the best way to form competent leaders. Rationality and logical thinking were reserved for a small elite, namely those who achieved substantial knowledge of abstract mathematics. Dijksterhuis believed, following the contemporary Dutch philosopher Gerard Heymans who I will discuss in the next section, that

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[314] De Jong & Van Lunteren, "Fokkers Greep"; Van Lunteren & Hollestelle, "Paul Ehrenfest".
[315] Klomp, *De Relativiteitstheorie*, pp. 129-132. Klomp cites correspondence between Kohnstamm and Ehrenfest dating from 1926; Ehrenfest later seems to have changed his opinion on Kohnstamm's indeterminism, see Van Lunteren & Hollestelle, "Paul Ehrenfest".
[316] Baneke *Synthetisch Denken*, in particular pp. 119-133.
[317] *Ibid*.
[318] On Kohnstamm, see Klomp, *De Relativiteitstheorie*.

only this group of rational thinkers was suited to partake in politics. At bottom, the mathematics debate between Dijksterhuis and Kohnstamm concerned a difference in their evaluation of the certainty of knowledge. Where Dijksterhuis believed, à la Plato and Kant, and again following Heymans, that certain knowledge about such issues as political matters was possible and should be arrived at through use of rational thought, Kohnstamm held that absolute knowledge could never be attained. According to Kohnstamm, not a strict rational education in Euclidean geometry, but a well-formed responsible 'personality' was needed to form moral judgments.

To come back to the relevance of relativity for this debate: Kohnstamm partly credited the insight that it was impossible to attain absolute knowledge to the appearance of relativity theory. Relativity undermined the validity of Dijksterhuis' cherished Euclidean axioms, as in relativity, rival geometries in fact seemed more advantageous. Furthermore, relativity also undermined Kantian philosophy, even though Einstein's theory did not directly make any claims about absolute certainty. But, by replacing absolute Newtonian space and time by a relativist spacetime, relativity did overthrow one of the foundations of Kant's absolute knowledge. As Klomp describes, exactly these arguments were used by Kohnstamm, Fokker and Ehrenfest-Afanassjewa against the likes of Dijksterhuis. Klomp concludes from this that because of its influence in educational reform, relativity made an important impact on the democratization of the Netherlands.[319]

In order to put Klomp's claim in perspective: Dijksterhuis remained the most influential person in debates about mathematics education, and in 1934, after seeking advice from both Fokker and Dijksterhuis, the Dutch government decided to retain Dijksterhuis' methods in mathematics education: reform took place only after World War II. Moreover, Dijksterhuis seems to have avoided his opponents' arguments derived from relativity for as long as possible. Although Klomp does not explicitly discuss Dijksterhuis' opinion on relativity, one might get the impression that Dijksterhuis was critical towards Einstein's theory from Klomp's account. In fact, Dijksterhuis' reaction was much more subtle. Whenever he needed to, Dijksterhuis would admit that relativity contradicted Euclidean geometry. This would however not affect his point of view on education, as Dijksterhuis would argue that Euclidean geometry still was the best way to teach deductive mathematics, and therefore the best way to 'form' students. On basis of his own work in history of science, Dijksterhuis argued that relativity was not nearly as revolutionary as its advocates claimed. The one true revolution in physics instead had taken place with Galileo and Newton, who were the first to apply mathematical methods to physics. Relativity was firmly rooted in this tradition, and Dijksterhuis stressed the continuation between Einstein and his predecessors. Dijksterhuis accepted that relativity gave a new explanation of certain phenomena, but believed that the metaphysical value ascribed to relativity was generally exaggerated.[320] As we will see, similar ideas on relativity were commonplace among 'conservative' thinkers, and were also defended by several experts.

Interwar philosophy: the influence of Bolland and Heymans

As has been discussed in chapter four, there were hardly any 'popular reactions' to relativity in the period before 1920. The only significant reactions were those of the engineer and lecturer in Wageningen M.W. Polak, the writer and physician Frederik van Eeden, and the professor of philosophy in Leiden G.J.P.J Bolland. The latter was both a controversial and an influential

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[319] *Ibid.* The previous sections give, in my opinion, a quite accurate reproduction of the main conclusions and arguments of Klomp's analysis of this debate.

[320] Klomp, *De Relativiteitstheorie*. On Dijksterhuis view on relativity, see also Van Berkel, *Dijksterhuis*, p. 150.

scholar, who, like Heymans, professor of philosophy in Groningen, exerted considerable influence on philosophical thought in the Netherlands around 1920. Heymans, who certainly appreciated scientific knowledge, reacted critically to relativity with a lengthy article in *De Gids*. As we will see, a large share of 'non-expert' publications on relativity was philosophically inspired. By analysing these reactions, some light will hopefully be cast on the relations between science and philosophy, and on the influence of science on worldviews and ideology. I will come back to Heymans in a moment. First, I will discuss Bolland's take on relativity. As already pointed out, many physicists such as Fokker and Clay would admit themselves that they had been influenced by Bolland's philosophy; therefore some further discussion of his ideas and impact should be warranted too.[321]

That Bolland was a controversial figure becomes clear from one of his last and most famous lectures, *De teekenen des tijds*, which was held in 1921. Bolland, who was by then already terminally ill and would die in February 1922, used this lecture to criticize modern society. Wrongdoers, according to Bolland, included modern technology, impudent youth, socialists, democracy and its incompetent leaders, but most of all: the Jews. Bolland's lecture has been characterized as one of the earliest and most outspoken expressions of twentieth century anti-Semitism in the Netherlands. There is however no evidence that Bolland's criticism on Einstein was driven by his anti-Semitism. As his biographer asserts, Bolland had become an anti-Semite only shortly before *De teekenen des tijds*.[322] Interestingly, *Het Volk* seized his lecture to juxtapose Bolland, "prophet of raging hicks" with none other than Einstein and Lorentz, who were considered benign scientists who would never stoop as low as Bolland.[323]

Bolland, as a Hegelian philosopher, was mainly interested in dialectics and advocated what he called 'pure reason'. During the 1910s, he relentlessly attacked those whose methods he did not agree with. Bolland was critical of natural science, and theoretical physicists in particular seem to have been one of his favoured targets. Already in 1901, one of Bolland's lectures had been retorted with an address by the physicist W.H. Julius. Julius contended that Bolland did not have even the slightest form of understanding of modern science.[324] But although physicists claimed that Bolland lacked the knowledge to participate in debates on their field, this did not stop him from voicing his depreciation of recent developments in physics. According to Bolland, the goal of physics should be to create an understanding of the natural world. As we have seen, the generation of physicist spearheaded by Lorentz and Kamerlingh Onnes instead emphasized empirical methods, and tried to refrain from metaphysical generalizations. Bolland clearly did not approve of this attitude, and voiced his opinion in ways that can be considered quite impolite. His attacks on Lorentz, whose reluctance to hold on to the ether was seen by Bolland as a result of unscientific metaphysics, even caused some of Bolland's physicists-followers to criticize their philosophical patron and, eventually, to turn away from him.[325]

Probably because of the style of his lectures, Bolland was far more popular outside the academic world than he was with his colleagues. Nonetheless, Bolland's legacy in philosophy is undeniable, and his school spawned a number of 'opponents' of relativity. After his death, his followers established a 'Bolland-society'. One of its leaders, Balthus Wigersma,[326] would in 1922 follow his master in criticizing relativity. In that very same year, Wigersma, in an obituary of

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[321] See Otterspeer, *Bolland*, for a comprehensive biography.
[322] *Ibid*.
[323] *Het Volk*, Ocotber 15, 1921, p. 3, "Oproerige krabbels".
[324] Otterspeer, *Bolland*, pp. 276-277.
[325] *Ibid*; Maas, *Atomisme*, in particular pp. 175-177.
[326] Weststeijn, "Op zoek", pp. 360, 370.

Bolland, also defended his master's anti-Semitic stances.[327] Nonetheless, Wigersma did not attack Einstein personally: as a review by a fellow Bollandist noted, "the writer has great admiration of the scientific genius of Einstein".[328] Unsurprisingly, this reviewer was quite positive of Wigersma's book, as he felt that it pointed out the brilliance of Einstein's scientific contribution, yet also showed the foolishness of his metaphysics.

Thus, even though he was an outspoken anti-Semite, Wigersma did not attack Einstein on a personal level. This clearly contrasts the situation in Germany and France, where opponents of relativity theory would often invoke anti-Semitism in their criticism, also when they primarily attacked relativity on an epistemological level.[329] This again indicates that in the Netherlands, science in general was considered to be objective and free of political influences. Wigersma criticism, for instance, instead focused on Einstein's philosophical points of view. According to Wigersma, a physics teacher himself, relativity ascribed to positivist metaphysics, which could not teach anything about the true value of science. As Wigersma argued, science should instead be "the sum of thoughts revealed in the mind":[330] experience and consciousness had to be taken into account. Science pertained not only to the mathematical expression of nature, but also to the development of the individual, as taught by Hegel and Bolland.

Van der Waals jr., who, as discussed, spoke out reservedly on the metaphysical implications of relativity, appreciated Wigersma's attempt at scrutinization of the philosophical side of the theory. Still, Van der Waals, in his own popularization of relativity, wrote that he "regretted that he could not convey the main concepts and mathematical formulation" of relativity to laymen due to its arcane nature.[331] Its foundational implications however still needed to be elaborated, and Van der Waals did not agree with its most common interpretations. But precisely because he considered Wigersma a "fellow-thinker", Van der Waals felt he had to react to the shortcomings of Wigersma's book, as he expressed in *Onze Eeuw*. These shortcomings were severe, and Van der Waals even wondered whether Wigersma had studied relativity himself, or if he instead only knew it through popular accounts.[332]

Van der Waals would develop the habit to react to popular publications on relativity. Fokker too reacted to such publications frequently, and he found little of value in Wigersma's account. He discussed it shortly in the physics journal *Physica*, and indicated above all that Wigersma had made many mistakes.[333] *Physica* focused specifically on research in and popularization of physics, and Fokker, very much concerned with popularizing science, had been one the key figures involved with *Physica* since the journal had been founded in 1921.

As we have already seen before, Fokker could react quite strongly to what he felt were misinformed accounts on relativity. Another of his victims and probably his most important one, was Gerard Heymans. In 1921, Heymans published his "lay-questions concerning relativity" in *De Gids*. Heymans, already before the turn of the century one of the most important intellectuals in the Netherlands, believed that Kantian philosophy taught that there were "indubitable evidences".[334] One of these was of course the validity of Euclidean geometry. According to Heymans, the veracity of these 'indubitable evidences' was *that* obvious, that those evidences were no longer subject to the test of physics: their truth was a matter of philosophy. Heymans himself, even though being one of the founders of the field of 'experimental psychology',

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[327] Otterspeer, *Bolland*, pp. 544-545.
[328] J.G. Watjes, "Review Wigersma", *Tijdschrift voor Wijsbegeerte*, 16, 1922, pp. 316-319.
[329] Wazeck, *Einsteins Gegner*, Van Kimmenade, *Resistance*.
[330] Wigersma, *Natuurkunde*, p. 4.
[331] Van der Waals jr., *De relativiteits-theorie,* p. 94.
[332] J.D. van der Waals jr., "Review Wigersma", *Onze Eeuw*, 23 II, 1923, pp. 359-361.
[333] A.D. Fokker, "Review Wigersma", *Physica*, 3, 1923, pp. 66-67.
[334] Heymans, "Leekenvragen", p. 93.

advocated a strict separation between philosophy and physics in his critique on relativity. According to Heymans, Einstein had wrongly attributed authority exclusively to observation and had thereby ignored philosophical evidence. Apart from the fact that relativity could be evaluated as a scientific theory, relativity presupposed some epistemological postulates. Heymans set out to attack both the scientific and the epistemological sides of relativity.[335]

Heymans' own philosophy held that strict rationality would lead to certain knowledge in the sciences. Furthermore, his psychology told him that in human matters, rationality would lead to moral judgments. This was one of Heymans main arguments in his political philosophy: as Heymans believed that only the intellectual elite would be able to think strictly rational, he had opposed the effectuation of universal suffrage in the first decades of the twentieth century. Interpretations of relativity such as those of Kohnstamm – who, just like for instance Clay and Van der Waals jr., had by the 1920s earned a serious reputation as philosopher[336] – now threatened Heymans views, and Heymans apparently felt he had to react to the theory.

Just like Wigersma, Heymans argued that Einstein held a positivist attitude towards science. Where, according to Heymans, the only way to arrive at sound scientific knowledge was to combine rationality with experiment, Einstein had only used the latter. For Heymans, relativity was a theory that mathematically described certain phenomena. This description, however, could only be sustained by a reinterpretation of the notions of space and time. The meaning of the concepts of time and space was however beyond doubt, and Einstein's interpretation was therefore invalid. Instead of an explanation of the relations between phenomena as the "older natural sciences" had presented, relativity only gave a mathematical description.[337] Heymans cited Polak's 1918 attack on relativity, and argued with Polak that there was a difference between mathematical correctness and physical correctness.[338] Both Polak en Heymans could not accept the 'purely mathematical' relativity theory, as they thought it contradicted 'common sense' and 'indubitable evidences'.

Fokker's reaction to Heymans, which was also to appear in *De Gids*, focused on yet another point of Heymans' criticism. Heymans had also argued that experimental evidence for relativity was lacking, and that it was certainly not strong enough to overthrow his certainties. The revolution from 'old' to 'new' physics had, according to Heymans, taken place with special relativity, and was therefore solely based on Michelson's experiment.[339] As Fokker's first version of his reaction to Heymans was rejected by *De Gids* because of a lack of respect for the eminent philosopher,[340] the philosopher and teacher at a military academy R.J. Kortmulder presented his answer to Heymans' critique before Fokker could do so. In the philosophical journal *Tijdschrift voor Wijsbegeerte*, Kortmulder, a specialist on metaphysics and the foundations of mathematics, asserted that Heymans' description of Einstein as a positivist was inaccurate. According to Kortmulder, Einstein had only protested the use of non-detectables as foundation of explanations; he had not at all argued that understanding could only be based on experimental evidence. Furthermore, Kantian a priorism was *not* the same as 'pure reasonableness': when Kant had argued for the absolute validity of Euclidean space, he had considered 'real space' identical with 'mathematical space'. Kant, according to Kortmulder, had to do so, as contemporary mathematics had not sufficed to conceive of space otherwise. However, mathematical developments now had allowed Einstein to do so. According to Kortmulder,

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[335] *Ibid.*, p. 87.
[336] De Jong & Van Lunteren, "Fokkers Greep", p. 12.
[337] Heymans, "Leekenvragen", p. 101.
[338] *Ibid.*, p. 107.
[339] Heymans, "Leekenvragen"
[340] Klomp, *De Relativiteitstheorie*, p. 85.

Einstein was not nearly as revolutionary in that aspect as Heymans had thought. Einstein only gave a physical interpretation to the mathematics developed by Richard Dedekind and Bernhard Riemann in the nineteenth century: general relativity was an obvious next step in the conception of space and time.[341]

The *Tijdschrift voor Wijsbegeerte*, although having a small audience, was quite influential among philosophers. Where the physics journal *Physica* dedicated ample room to popularization, the *Tijdschrift voor Wijsbegeerte* in general only printed serious philosophical texts. Editors included Heymans, Clay, and many other influential scholars. Both Kohnstamm and Van der Waals were contributors to the journal. Its first article on relativity appeared in 1921. In that article, Kohnstamm reviewed a book on relativity by the German philosopher Felix Meiner. Kortmulder's reaction to Heymans appeared in the same year. In 1922, another number of articles on relativity were published. Among these was an article by the most notorious critic of relativity in the Netherlands: M.W. Polak. His earlier attacks on the theory of relativity comprised of a booklet published in 1918 and two polemics, the first in *De Ingenieur* with Fokker, the second in the *Handelsblad* with Schouten. In the meantime, Polak had in 1920 also reacted in the popular science magazine *De Natuur*, where the student H. van Tongeren in his sixty-page popularization of relativity had taken several shots at Polak, who, according to Van Tongeren, had misunderstood relativity completely. Polak reacted to Van Tongeren with a reference to his own work, and argued that he would not enter a debate with someone who tried to belittle him.[342] In his article in the *Tijdschrift voor Wijsbegeerte*, Polak argued once again that relativity contradicted common sense and intuition. According to Polak, the "relativists" one-sidedly focused on "experimental experience". "The intuitive notion of time" was however an 'experience' too. Experimental evidence and intuitive notions were thus of the same level, and Polak stressed again that the 'conception' of time could therefore not be neglected, as relativity in fact did, according to him.[343]

As we have seen, Fokker had already reacted to one of Polak's earlier publications dismissively, and especially turned against the idea that 'evident' or 'intuitively true' concepts were 'above physics', as Polak had put it. In that respect, the comments of Heymans and Polak were very much alike. In his answer to Heymans, which was eventually published in *De Gids* in the fall of 1922, Fokker again pointed out that one of the main achievements of Einstein's relativity theory was that it had "constructed new conceptions". According to Fokker, axioms were not postulated because they were self-evident, but because they could not be proven. The function of axioms was not to make explicit what was already clear, but to provide logic and consistency to a theory.[344] The merit of Einstein's work was that it had recognized in what had previously seemed a most useless theory, namely non-Euclidean geometry, the most appropriate and unconstrained way to approximate reality.[345] On Heymans' point that the entire 'revolution' of relativity was based on one experiment, namely that of Michelson and Morley, Fokker could now point out that this was most certainly not true. Instead, the acceptation of relativity was based on the fact that, as a new principle, it had been able to relate a whole group of "experimental results" to each other. Fokker pointed to the fact that relativity could give a much simpler explanation of for instance the Trouton-Noble experiments on ether drift than earlier work had done. Furthermore, because of relativity, such experiments could now easily be

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[341] Kortmulder, "Relativiteitstheorie", in particular pp. 301-303.
[342] M.W. Polak, letter to the magazine, *De Natuur*, 40, 1920, p. 376.
[343] Polak, "De relativiteitstheorie".
[344] Fokker, "Relativistische studie", pp. 262-263.
[345] *Ibid*., 268.

related to experiments on mass-dependent velocity as had been performed by Neumann, and by Guye and Lavanchy.[346]

Fokker's own thoughts on relativity are quite interesting too. As an opponent of Heymans' philosophy and Dijksterhuis' educational ideas on the one hand, and a student of Bolland on the other hand, Fokker's ideas were very much influenced by philosophical debates. As is discussed by historians of science De Jong and Van Lunteren, Fokker proposed a holistic worldview based on relativity in his later work. According to Fokker, there was one unique reality consisting of a four-dimensional relativistic world. In this world, all events were related to each other: in determining of the course of events, knowledge of the future was indispensible. Fokker even proposed that events in the 'future' could have causal effects in the present. The future, according to Fokker, was as much part of the holistic world, and thus of reality, as the past and the present. In Fokker's thought, there was no strict separation between space and time, and because of his reinterpretation of those two concepts, Fokker thought he was able to circumvent problems that pertained to determinism and strict causality.[347]

Although De Jong and Van Lunteren argue that both holistic and teleological elements were present in Fokker's view, they do not relate these directly to the philosophy of Bolland. From what they describe however, it seems that Fokker was in fact looking for some kind of Hegelian understanding of natural science: understanding the world as a whole was his final objective. Anyway, Fokker was very much interested in and influenced by contemporary philosophy, and so was his counterpart in this chapter, Van der Waals jr. The latter's stance on philosophy are easier to qualify. Van der Waals, as already discussed, was educated in neo-Kantian philosophy by Bellaar Spruyt in his student years, and Kantian concepts remained important for Van der Waals during the rest of his career. His thoughts on the new conceptions of space and time as a result showed clear similarities with those of Heymans.

In an article in *Onze Eeuw* in 1921, Van der Waals took up the question of the nature of space.[348] According to Van der Waals, discussions about whether or not relativity entailed a non-Euclidean geometry could only be understood when the meaning of the notion 'space' was truly appreciated. Van der Waals contended that to arrive at such an appreciation, one had to discriminate between mathematical, physical, and 'original' spaces, where only the latter were actually 'conceivable'.[349] Mathematical spaces on the other hand had nothing to do with reality, they concerned only possibilities: spaces with more than three dimensions surely did not exist in reality. More difficult was the concept of non-Euclidean space. Van der Waals argued that non-Euclidean space was basically a mathematical space. However, relativity supposedly had shown that 'physical space' too was non-Euclidean. Van der Waals now asserted that he would not disagree with that, but that he would further inquire into the meaning of the concept of 'physical space'.[350] Physical space namely was not the same as the original, conceivable space, and *that* was the kind of space whereof one could know a priori that it would be an Euclidean space, as Kant had claimed.

Physicists, according to Van der Waals, would not agree with him on this point, as they were not looking for a *conception* but for the *properties* of space. However, to Van der Waals, 'space' was nothing but a conception. Where one could argue on basis of general relativity that space was deformed by gravitation, one could as well argue that not space itself, but the

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[346] *Ibid*., p. 263. On the Trouton-Noble experiment and its influence on relativity, see Janssen, "Reconsidering". For Neumann, Guye and Lavanchy, see Staley, *Einstein's generation*, pp. 254-257.
[347] De Jong & Van Lunteren, "Fokkers Greep". Fokker's ideas have also been discussed in Klomp, *De Relativiteitstheorie*, see especially pp. 55-61.
[348] Van der Waals jr., "Over de ruimte".
[349] *Ibid*., p. 60.
[350] *Ibid*., p. 73.

standards of measurement were deformed. Because of that, Van der Waals argued, relativity theory had nothing to say about original space, it only concerned physical space. On epistemological grounds, it was certainly possible to maintain a Kantian conception of space, and that was Van der Waals' own preferred interpretation.[351] Van der Waals nonetheless did believe that general relativity was one of the greatest achievements in modern physics and that Einstein's theory had to become "a guiding principle" for further research.[352] But, as he argued in 1923, the fact that the curved-space-interpretation was prevalent, was not a logical necessity; it was a consequence of its importance in the development of relativity theory. In special relativity, which Van der Waals still mainly credited to Lorentz,[353] the relativistic conception had not been important, one could as well use another interpretation. Only the fact that Einstein's general gravitational theory would not have come into existence without this relativistic conception of space had caused the prominence of the 'relativity interpretation'.[354]

What we have seen so far is that relativity received considerable philosophical attention, mostly because of the fact that it undermined some of the foundations of philosophical conceptions. Philosophers tried to deny relativity authority in metaphysical matters. They did so by demarcating physics as well as their own field; subsequently they argued that physics and philosophy were to be kept separate. We will encounter similar strategies throughout this chapter. In general, philosophers tried to reinterpret relativity in such a way as to make it consistent with their own ideas; what they in fact did, was restricting the influence of relativity. Fokker and Van der Waals would of course not agree with that easily. I will come back to this tension in a moment; first, I will further illustrate this process with some other reactions based on the philosophies of science of Hegel and Kant.

For Van der Waals, the most interesting aspect of the theory of relativity evidently was its metaphysics. We have already seen his reaction to Wigersma, and when in 1923 another Bollandist published his own thoughts on relativity theory, Van der Waals again took it upon him to review the work. This booklet, written by the engineer J.M Steegstra, is one of the most curious pieces I have encountered in this research. In his introduction, Steegstra argued that the 'true meaning' of relativity, in terms of its contribution to the understanding of nature, had not yet received much attention. As Hegel had argued though, physics in fact should primarily be about worldviews and philosophy, and Steegstra set out to find relativity's influence in those areas. Steegstra made a clear distinction between classical and modern philosophies of nature. In the classical understanding, space had primacy over matter, as matter was defined as a quality of an object at a certain position. Nonetheless, space was not to be understood in a Newtonian sense: according to Steegstra and Hegel, an entity such as empty space had no meaning. Instead, space was to be considered in the way it was actually present. As Steegstra contended, in the new philosophy of nature embodied by relativity theory, primacy had moved back from space to matter. Matter was no longer seen as defined in space. In contrast, because of its effects on curvature, matter now *determined* space in relativity theory.[355] Via a philosophical discourse I will omit here, for Steegstra, this led to a new understanding of 'freedom'. In classical natural philosophy, freedom could be 'defined' as the absence of mass, and light therefore was the ultimate expression of freedom: it could travel through space unimpaired. In modern natural philosophy, Steegstra argued, mass and matter would lead to a "regulative nature" in which

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[351] *Ibid*., in particular pp. 78-80.
[352] *Ibid*., p. 84.
[353] Van der Waals jr., *De Relativiteits-theorie,* pp. 92-93.
[354] *Ibid*.
[355] Steegstra, *Ruimte en materie*, pp. 5-8.

events would occur in a forced manner. Therefore, classical philosophy was to be preferred, as it could explain freedom in a natural way.[356]

Van der Waals did not quite react positively to Steegstra in his review in *Onze Eeuw*, although the former still expressed the hope that there would be more discussion on the interpretation of relativity. Van der Waals once again argued that in order to analyse relativity, it was necessary to understand the theory and its mathematical elaboration in full.[357] Perhaps in reaction to this review, which appeared at the end of the summer of 1923, Steegstra would criticize relativity again by means of a note in *De Ingenieur*. When Van der Waals' own *De Relativiteits-theorie* had been positively assessed by the engineer J. Goedhardt, Steegstra commented on this review in the September issue of *De Ingenieur*. Especially disagreeable for Steegstra was the fact that Goedhardt agreed with Van der Waals on the point that knowledge of relativity's mathematics was a necessity in order to evaluate the theory. Steegstra argued that relativity was founded on wrong conceptions, a fact that could not be shown mathematically. Concepts such as curved space and curved light beams were simply unacceptable; one did not need mathematics to see that. This episode turned into a polemic when Goedhardt replied to Steegstra's note, but nothing came of it, as Goedhardt and Steegstra did not really reacted to each other's main arguments.[358]

By now, the story of another Hegelian critic of relativity, Max Greeve,[359] will sound very familiar. Nonetheless, I will discuss it shortly, as Greeve's account clearly illustrates some particularities of the Dutch reception of relativity. Greeve attacked the theory of relativity because of its overly mathematical character and its irrational conception of time. There was no personal attack on Einstein, Greeve respected Einstein work as, "his mathematics were perhaps brilliant"; nonetheless, Greeve argued that Einstein had "disregarded all reasonableness". For Greeve, the problem with relativity was a lack of respect for experience and metaphysics. Greeve contended that the theory of relativity had created an "ultrascientific haze", which obscured its mistakes.[360] Greeve's account was published as a booklet, just like those of Wigersma, Steegstra, and Polak. It is hard to ascertain how many readers such booklets would have had, but we can assume that numbers of readers were small, although Wigersma's account seems to have been rather popular.[361]

The main difference between Greeve and other Bollandist critics we have encountered, is that Greeve's attack had a much more aggressive style. Greeve's account was the first part of a series of "critiques by laymen", of which the second would be "on the love of truth in philosophy", and would written by the same Max Greeve.[362] Of course, Van der Waals reviewed the booklet on relativity: he had little good to say about it. Straight away, Van der Waals questioned the motives of the publisher of Greeve's work. Could there be any solid reason to publish a work that showed such ignorance of the topic it discussed? Besides uninformed criticism of relativity, Greeve, as Van der Waals put it, "strayed away to his other hobbies".[363] For

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[356] *Ibid*., in particular pp. 38-43.
[357] J.D. van der Waals jr., "Review Steegstra", *Onze Eeuw*, 23 III, 1923, p. 268.
[358] Steegstra & Goedhardt, "De relativiteitstheorie"; "De relativiteitstheorie II".
[359] Interestingly, although Greeve felt that Bolland, like Hegel, had been able to "clarify the highest wisdom", Greeve regretted Bolland's *De teekenen des tijds*. See Greeve, *Onhoudbaarheid*, p. 16. Although clearly inspired by Bolland, Greeve lacked the submissivness to Bolland that can be found in for instance the critiques of Wigersma and Steegstra.
[360] Greeve, *Onhoudbaarheid*, especially pp. 3-4.
[361] According to Klomp, Wigersma's booklet was printed a second time already in 1922. See Klomp, *De Relativiteitstheorie*, p. 258, note 212.
[362] See Ph. Kohnstamm, "Review Greeve", *Onze Eeuw*, 23 III, 1923, pp. 388-389.
[363] J.D. van der Waals jr., "Review Greeve", *Onze Eeuw*, 23 I, 1923, pp. 265-267.

some reason, Greeve was very much bothered by Frederik van Eeden's recent conversion to Catholicism, and made this clear in his booklet. Greeve also kept complaining about wrong uses of philosophy. According to Greeve, "the triumph of obscurity, mysticism, and credulousness" in art, philosophy and science, which Van Eeden supposedly seemed to hail in Catholicism, was a threat to culture in general, and could only be countered with philosophy based on 'clarity'.[364]

With his explicit emphasis on his status as layman and his fierce attack on modernist thought, Greeve seems to resemble some of the German critics of relativity identified by Wazeck. One essential characteristic of the *Welträtsellöser*, Einstein's non-academic opponents, is however missing in Greeve's account. Where the *Welträtsellöser* held an anti-academic attitude, Greeve was only concerned about an overly use of mathematics and a disregard for clear reasoning. These characteristics, however, was what he, as a layman, *expected* from scientific popularization. The fact that 'clearness' was lacking in relativity, certainly did not mean to Greeve that laymen would do any better than Einstein. In fact, the scientific decadence Bolland and Spengler had pointed to, did not exist according to Greeve. Instead, he seems to have held the "bankruptcy of religion" responsible for the problems of the modern world[365] – this of course helps to explain his issues with Van Eeden's conversion to Catholicism.

I will discuss one last reaction to relativity that was clearly inspired by Bolland's philosophy. This reaction was published in the cultural journal *De Nieuwe Gids*, and was authored by the famous writer Lodewijk van Deyssel. Particularly in the 1880s and 1890s, Van Deyssel had been successful as a member of the movement of the *Tachtigers*, whereto *De Nieuwe Gids* was closely associated. The influence of the *Tachtigers* and *De Nieuwe Gids*, in which Bolland himself had actually published regularly, had however long waned. Nonetheless, Van Deyssel's short essay on relativity attracted attention from both *Het Vaderland* and *De Telegraaf*, and both newspapers gave a short summary of Van Deyssel's arguments.[366] As could be expected, Van Deyssel's main argument was that common sense, which he considered equally useful in science as "geometrical formulations and abstract philosophy", immediately proved that relativity theory could not be right.[367] Van Deyssel cited a German popularization of relativity by the popular author Alexander Moszkowski, and showed that on basis of examples given in that book, one clearly could not claim that space and time were not absolute entities.[368] That Moszkowski's book did not give a sound explanation of relativity, had however also been recognized by Einstein himself, who had even attempted to stop Moszkowski's publication. Although this was largely because Einstein, pressed by his friend and fellow physicist Max Born and the latter's wife Hedwig, believed that Moszkowski's book would confirm the anti-relativists' claims about "shameless self-promotion" of the relativists,[369] Einstein's actions were most likely also related to Moszkowski's inadequate understanding of the theory. Nonetheless, Einstein's attempts to stop the publication had evidently been unsuccessful.

Thus, what we have seen over the last few pages is that there was a significant influence of philosophical thought on the reception of relativity. The two experts most involved with the popular reception of relativity in the early 1920s, Van der Waals and Fokker, as well as some of its other main proponents, were very much interested in metaphysical and philosophical issues. Philosophers themselves, too, considered relativity to influence their sphere of interest. Although many reactions to relativity were published as small booklets or in esoteric journals

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[364] Greeve, *Onhoudbaarheid*, p. 38.
[365] *Ibid*., p. 27.
[366] *De Telegraaf*, February 11, 1922, p. 10, "Van Deyssel over de relativiteitstheorie"; *Het Vaderland*, February 11, 2911, p. 4, 'Tijdschriften: Nieuwe Gids".
[367] Van Deyssel, "Einsteins relativiteitstheorie", p. 153.
[368] *Ibid*., p. 157.
[369] See Van Dongen, "Reactionaries and Einstein's Fame", p. 224.

and hence had a rather small audience, the philosophical discussion certainly aroused interest among the general public. Several of the 'philosophical reactions' to relativity were discussed in newspapers, especially those by influential figures.[370]

Now that we have seen the responses to relativity by Heymans and Van der Waals, responses which were both inspired by the philosophy of Kant, we are now also able to draw some conclusions about the connection between the theory of relativity and philosophical relativism. This was certainly not a mere confusion between two resembling words. Heymans in fact believed that relativity threatened the concept of self-evident knowledge on which his thought and in particular his political philosophy were founded. Although relativity in itself did not propose a new worldview, it did undermine Newtonian space-time and the validity of Euclidean geometry. By that, it compromised the foundations of a priori knowledge as proposed by Kant. The mathematician Gerrit Mannoury, himself a radical socialist who in fact supported philosophical relativism, argued for instance that although relativity in itself had nothing to do with relativism or absolutism, it had meant much for his thought indirectly, as it had overthrown the foundations of earlier thought.[371] Heymans' absolute rationality was no longer sustainable if relativity would be accepted; the same held for instance for Steegstra's identification of massless light as the ultimate expression of freedom.

The theory of relativity, because it overthrew 'classical physics' and thereby the foundations of many worldviews, thus had far-reaching philosophical consequences. The fact that 'relativists' still claimed that relativity had in fact very little to do with metaphysics, of course made things even worse. How could such a positivistic theory sweep aside established worldviews? However, interest in metaphysics was not something particular to the reception of relativity. We have seen that for instance Fokker and Kohnstamm were involved in debates on determinism and causality; these debates had already been prominent around the turn of the century. In particular the 'bankruptcy of science' debate influenced later thought. This debate centred on the *hubris* of science: in the nineteenth century, science had promised social progress, but in fact, science had not been able to create any understanding about such issues as human morality and the destiny of mankind. At the same time, modern technology had not only been helpful; it had also led to estrangement from nature and fragmentation of society. Even though the bankruptcy debate was much less severe in the Netherlands than it had been in for instance France, it did have an impact. Materialism and positivism were widely rejected among Dutch intellectuals. Instead, scholars started working towards a morally responsible science.[372]

Although such debates resulted in pessimism towards science in some quarters, it is important to notice that only the intellectual elite, which of course included scientists themselves, was involved in these debates. As we have seen, the public in general had high expectations of science in the first decades of the twentieth century, and its cultural status was undisputed. Debates on science and worldviews did seep through to popular culture, but their interpretation and impact would change considerably in due course. This for instance manifested itself in the relativism issue. Where for instance Heymans and Wigersma would argue that relativity *undermined* absolute certainly, in newspaper coverage this was immediately extended to the idea that relativity entailed full-fledged philosophical relativism: the idea that relativity entailed that 'everything is relative' was expressed widely, as we have seen in the previous chapter. But where Heymans and Wigersma argued that this invalidated

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[370] On for instance Heymans' article in *De Gids*, see *Het Vaderland*, April 5, 1921, p. 8, "Tijdschriften: De Gids", *NRC*, April 5, 1921, p. 3, "Wetenschappelijke berichten". On Fokker's response, see *Het Vaderland*, November 7, 1922, p. 6, "Tijdschriften: De Gids".
[371] Klomp, *De Relativiteitstheorie*, pp. 113-115.
[372] Baneke, *Synthetisch Denken*, in particular pp. 124-133.

relativity as 'true science', in popular culture the link between relativity and relativism only contributed to the status of modern science. The relations between relativity and esoteric philosophy only enhanced the allure of the theory in public opinion. The idea that a mysterious theory had all sorts of important conclusions was closely related to the idea that science was, and should be, unintelligible for laypeople. That idea was actually enjoyed by many.

But, in intellectual culture, the beginning of the twentieth century thus saw an uptake in the interest in the role of science in philosophy, and its influence on worldviews. This philosophical interest, of course, was very much related to the institutional changes in science discussed in chapter two. The new position and prominence of science in its 'social' role spawned debates on what science was and what could be expected of it, and further intensified debates on the foundations of science. That these debates also had a practical side has become clear from Klomp's account. The educational reforms proposed by its participants originated in the philosophical debate, but, via ideas on the foundations of knowledge and the forming of competent citizens, were ultimately an answer to the process of democratization and the underlying ideology of that process. For instance Kohnstamm's pedagogy, as discussed, aimed at preparing students for an active role in democratic life. In discussions on educational reform, 'self-evident knowledge' and 'freedom' were key notions, and thus held both philosophical and practical connotations.

At the same time, philosophical debates would of course also be fuelled by the allure philosophy acquired under the two great Dutch philosophers of the time: Bolland and Heymans. The generation of scientists that rose to prominence during the first two decades of the twentieth century therefore became involved in these philosophical issues almost naturally. These scientists might even felt to be forced to partake, as their profession was questioned. Scientists of the earlier generation such as Lorentz and Kamerlingh Onnes had already acquired their positions long before the bankruptcy of science debate took of.[373] They were much more used to practice a *science pour la science*.[374] The idea that science had to take notice of concepts like intuition and human values, that is, the idea that science had to pay attention to its moral dimensions, probably seemed strange to the older generation, while it had almost become self-evident for the younger scientists such as Clay, Kohnstamm, Van der Waals jr. and Fokker.

In Germany, a similar situation arose, as is remarked by historians of science Schirrmacher and Thoms. Where scientists as Röntgen and Planck, contemporaries of Lorentz and Kamerlingh Onnes, were conservative in involving science in politics and popularizing their work, the generation of Einstein, Born and Schrödinger, in turn contemporaries of Kohnstamm, Van der Waals jr. and Fokker, was much more willing to interact with the public.[375] In Germany too, intellectual climate and foundations of science became very much intermingled during the first two decades of the twentieth century due to debates on the role of science. As Paul Forman has argued his influential article on Weimar physicists, these debates particularly came to the fore after the Great War, when German scientists, according to Forman, developed a defensive attitude to a "hostile environment".[376] Thus, both in the Netherlands and in Germany, scientists changed their attitude towards the public in reaction to philosophical debates.

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[373] *Ibid*.
[374] Maas, *Atomisme*.
[375] Schirrmacher & Thoms, "Neue Wissensofferten", p. 106.
[376] Forman, "Weimar Culture".

Specialists, professionalization and amateurs

In chapter four, we have already seen that before the outbreak of mass interest in relativity, scientists to a large extent controlled the popularization of the theory. The previous section has shown that they certainly continued their efforts after 1919. Van der Waals jr. for instance emphasized the importance of a solid knowledge of the mathematical formulation of relativity in almost all of his reviews of popular works on the theory. Without such knowledge, an accurate understanding of the theory was impossible, according to Van der Waals. Fokker too, in his reviews of Polak, Heymans and Wigersma, pointed to the mistakes in their writings. Of course, the fact that physicists pointed to mistakes and the importance of solid knowledge of mathematics is in itself not remarkable. But again, just as in the early reception of relativity the *number* of popular lectures on relativity was in fact striking, so it is important here to notice the *persistence* of Van der Waals and Fokker to protect their own authority in matters that pertained to the theory of relativity.

The message these physicists ultimately conveyed, was that the field in which laypeople could interfere with the theory of relativity was strictly demarcated: in the end, only expert physicists were capable of a correct assessment of the interpretation of relativity theory and its impact on worldviews. Especially philosophers would object to that message: the interpretation of space and time, its metaphysics, had always been part of their terrain. As we have seen, the French philosopher and psychologist Henri Bergson vehemently protested against any limitations on the realm of philosophical thought posed by physicists. To counter their growing influence, Bergson introduced the notions of philosophical and psychological time. The true nature of time could only be decided on by philosophy: physics and psychology could contribute to the understanding of time, but could not provide decisive arguments about its essence.

It is interesting to note the similarities between Bergson and Heymans. Although Heymans' status in philosophy cannot be compared to that of Bergson in the least – Heymans' influence was largely restricted to the Netherlands, while Bergson was one of the most important philosophers worldwide – they can in many aspects be considered as counterparts. Both were major philosophers with a clear interest in the natural sciences, and both actually contributed to them, and especially to psychology. Heymans and Bergson also both believed that absolute knowledge was possible, and considered some aspects of relativity to be a threat to their metaphysics. To counter this threat, they introduced different 'understandings' of space: physics only pertained to its own type of space, and could not reach conclusions about actual conceivable space.

A similar argument was made by the Dutch chemist and metaphysician J.E. Enklaar, who published his thoughts on space and time in *De Gids* in 1923. For Enklaar, a clear demarcation between philosophy and science was key to the appreciation of the nature of space. With a historical survey of the development of the concepts of space and time, Enklaar aimed specifically at clarifying this demarcation.[377] Enklaar first discussed Isaac Newton, whose concept of space had not been sustainable as its proposed absolute space and time were not actually measurable. After his discussion of Newtonian thought, Enklaar described the conflicting eighteenth century contributions to the philosophy of space and time made by Leibniz, Euler and Berkeley. According to Enklaar, eighteenth century debate had been settled by Kant, and peace had returned. However, the debate came back to life in the nineteenth century when relativism came to the forefront of philosophy. Mach, "leader of the relativists", following Leibniz' critique of Newton, argued that space and time were only relative concepts. To Mach, these concepts were useful only when they were used to describe relations between

[377] Enklaar, "Tijd en Ruimte", p. 405.

events or objects. According to Enklaar, however, Mach had only been destructive in overthrowing the foundations of the older space-time concept. In order to insert Mach's ideas into a physical theory, "architects" such as Lorentz and Einstein had been required.[378]

Enklaar thus celebrated the achievements of relativity theory and its creators, but as we will see now, he very much downplayed relativity's authority at the same time. To conclude his historical survey, Enklaar specifically asserted that the difference between "naturalists" and "metaphysicians" was that those that belonged to the former category – for instance Newton, Lorentz and Einstein – were only interested in predicting future events. As these physicists came from a positivistic discipline, Enklaar contended, they would leave it to philosophers to conceive of a new worldview. Scientists always had built their work on thoughts of their predecessors, and science therefore showed a continuation that metaphysics lacked. According to Enklaar, the metaphysician was always on his own, and therefore created his own thoughts. Physics thus had only very limited power in the sphere of philosophy, as philosophy *had* to start from scratch every time. The fact that some concepts were no longer in use in physics, would, as Enklaar argued, not have any consequences for philosophy. Relativity had driven the concept of "the absolute" out of science, but 'absolute certainly' could find a save haven in philosophy or religion, where "no naturalist could affect it".[379]

Enklaar clearly made the same division between physical and philosophical space that we have already seen by Heymans and Bergson, but, remarkably, also by Van der Waals. All these scholars were keen to raise a barrier between physics and philosophy. By that, they tried to shield their own field of interest from outside influences, and *de facto* reinforced specialization in the sciences. The fact that Bergson included 'psychological time' as an important factor while Van der Waals on the other hand introduced 'mathematical space' next to the physical and conceivable ones, is also striking. Both Bergson and Van der Waals divided the understanding of nature in even more fields, but both made sure that they would remain in a position to make judgments on these new entities: Bergson was a pioneer of psychology, and Van der Waals as a theoretical physicist of course had the competence to engage in a mathematical debate.

Such restrictions on scientific competence strongly resonate with Bensaude-Vincent's ideas about the creation of a gap between science and the public which I have discussed in the introduction.[380] Similarly, Jonathan Topham has argued that, although "the extent to which […] 'popular science' [has] been intended to exclude individuals from knowledge making has always been contested", popular science has in fact been used frequently to organize and constrain the participation of these individuals.[381] Topham's conclusion is drawn mainly from work on nineteenth century popular science, and is based on the idea that "exclusionary usage" of popular science would be counterproductive to two of the main motives scientists had for popularization. Both these motives, earning additional income from popular work and persuading amateurs to participate in the forming of knowledge, could only be harmed by excluding laypeople from science, Topham asserts.[382] Even though the exclusions and constraints debated by Topham and Bensaude-Vincent concern mainly the demarcation

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[378] *Ibid*., in particular pp. 63-67.
[379] *Ibid*., pp. 76-77. Enklaar's article was published in 1923. Enklaar probably benefitted from the fact that at that point the board of editors of *De Gids* did not include any scientists. Van der Waals would join in 1925; Kuenen had died in 1922. Particularly for Van der Waals, it seems unlikely that he would have agreed with Enklaar's article. Besides his strong claims about the restriction of physics, Enklaar did not exactly distinguish himself by a clear presentation of relativity theory.
[380] Bensaude-Vincent, "A genealogy".
[381] Topham, "Introduction", pp. 315-316.
[382] *Ibid*., p. 316.

between professionals and amateurs, while the Dutch discussion about relativity involved divisions between distinct disciplines, their work is certainly helpful here; I will come back to these issues in a moment.

Van der Waals, Enklaar and Heymans all retained a distance between philosophy and science, and did so in order to defend their own authority. With their claim that relativity was a positivistic theory, both Heymans and Enklaar tried to deny relativity authority in philosophical matters, even though Enklaar was much more positive about the theory of relativity than Heymans. Van der Waals on the other hand argued that only those with the necessary mathematical expertise could really understand the theory. Interesting though, is the fact that even if scientists in general would agree on that point with Van der Waals – see for instance the reactions of Fokker and Schouten to Polak, and the attempts of Lorentz and Ehrenfest to explain the mathematical concepts used in relativity – they did feel that non-experts could acquire *some* knowledge on relativity. This fact, which is of course most prominently expressed in their numerous popularizations that included technical details, is particular for the Dutch case. In for instance Britain, most experts would argue that it was almost impossible for laymen to comprehend anything about relativity.[383]

As we have seen, Lorentz was very surprised by the British attitude, and claimed that the foundational ideas of relativity were not at all esoteric: in fact, Lorentz praised their simplicity.[384] Dutch physicists did try to educate their public on relativity, which of course had to do with the fact that the Leiden physicists themselves were very much interested in the theory of relativity. As it comprised a main part of their research, they were eager to create public support for the theory of relativity. Although we have seen that Fokker argued that it was almost impossible for laypeople to comprehend anything about modern physics, Lorentz seemed to have thought otherwise. Probably, at least some of the Leiden physicists did actually believe that it was possible for the average laymen to acquire some understanding of relativity. This difference in alleged comprehensibility of relativity between the Netherlands and Britain is therefore partly a difference between their respective scientific communities. It however also points to the more fundamental differences in public perceptions of science. In Britain, the "science lobby" increasingly focused on exciting and practical topics.[385] In the Netherlands, were science was still considered an important cultural factor, it instead seems to have been desirable to have thorough knowledge about recent scientific developments – even though this was certainly also the case for certain groups among the British public.

Nonetheless, in Holland, science was clearly not only esteemed for its possible technical and industrial benefits, as Fokker seemed to have feared it would be: the reception of relativity did not at all centre on its applications or possible use in technology. According to Schirrmacher and Thoms, however, this is not surprising, as the absence of practical uses of science in general is not a reason for a lack of public interest. From two case studies of popularization of science in Germany in the early twentieth century – the receptions of atomic physics and the theory of vitamins respectively – they argue that connections with knowledge or debates that were already present in public discourse are far more important for successful popularization of science.[386] Such connections were certainly present in the case of the reception of relativity in the Netherlands, as I have discussed abundantly. These connections, as well as Dutch self-identification with Einstein and his theory and the prominent role of science in the Netherlands,

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[383] Price, *Loving faster than light*, pp. 24-26.
[384] Lorentz, "De zwaartekracht".
[385] Bowler, *Science for All*, p. 11.
[386] Schirrmacher & Thoms, "Neue Wissensofferten", p. 102.

certainly aroused public interest in relativity, and help to explain public desirability to have more than rudimentary knowledge about it.

This desirability of scientific knowledge also explains another segment of publications on relativity. Following professional scientists, several amateur popularizers tried to make the theory of relativity accessible to laypeople, and various popular expositions of relativity written by scientific enthusiasts appeared in the early 1920s. These booklets would often claim that they used as little mathematics as possible in order to make knowledge of relativity attainable for a large audience. As Van der Waals would argue, these publications reproduced the technicalities of the theory "without critique and without an own point of view",[387] and did not "make any excursions on metaphysical terrain"[388] (notice that Van der Waals also reviewed this type of publications). Showing that relativity was not esoteric was of key importance to amateur popularizers; one author for instance stated in his introduction that he hoped that the could eliminate the "through cursory summaries or the terrible 'Einstein Film' by many entertained impression, that for a normal person relativity would be unintelligible or that it would even be a structure of shrewd moves that contradicts common sense". He further hoped that he could replace this impression with admiration for Lorentz, Minkowski and Einstein.[389]

The popularity of relativity in the early 1920s is also illustrated by the fact that journals such as the *De Groene Amsterdammer* published multiple small articles that discussed the meaning of relativity in that period. In October 1920, one of its journalists for instance argued that mass interest in relativity certainly legitimized extensive popularization, and gave a short overview of the main elements of special relativity. He however argued that Einstein's theory of gravitation was much harder, and could not really be understood by those who did not have the proper mathematical training.[390] In 1923, 'Aërobates' discussed the question whether or not, according to relativity theory, the Earth rotated. As explained by Aërobates, general relativity had dismissed absolute space, and only allowed for rotation with respect to other objects. In the end, Aërobates found that the consequences of relativity involved so much philosophy and metaphysics, that the theory could not really provide a satisfying answer to his problem.[391] *De Groene* also enabled the chemist W. Tombrock, who would author several books criticizing both relativity and atomic theory in the late 1920s and 1930s, to voice his criticism in a short article in 1924. According to Tombrock, common sense would immediately show that there was only one real 'time'. All other times introduced by relativity could only be mathematical devices devoid of real meaning, just like the phrase "parallel lines intersecting at infinity". Such phrases might be helpful, but one needed to be aware at all times that they did not have anything to say about reality.[392]

Thus, there clearly was a demand for popularization and discussion of relativity theory in the Netherlands. People were very much interested in the newest theory of modern physics, even when they were being told it would be very difficult. 'Expositions without an own point of

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[387] J.D. van der Waals jr., "Review Beer", *Onze Eeuw*, 22 II, 1922, p. 232.
[388] J.D. van der Waals jr., "Review Verrijp", *Onze Eeuw*, 23 II, 1923, p. 358.
[389] Borgesius, *De Relativiteitsleer*, p. 4. "Ik hoop […] bij velen den door wat al te haastigen overzichten of door de vreeselijke "Einsteinfilm gevestigden indruk, dat de relativiteitstheorie voor een gewoon mensch onbegrijpelijk of zelfs een met het gezond verstand strijdig samenstelsel van spitsvondigheden zou zijn, te mogen wegnemen".
[390] J.F. van Oss, "Iets over de theorie van Einstein", *De Groene Amsterdammer*, October 23, 1920, p. 8.
[391] Aërobates, "Atronomische fragmenten: 11. Nog eens de aswentelling der aarde", *De Groene Amsterdammer*, August 18, 1923, p. 2.
[392] W. Tombrock, "Een weinig bemerkte fout", *De Groene Amsterdammer*, October 4, 1924, p. 5.

view' written by such amateurs became fashionable,[393] and even some popular accounts of relativity that did well in other countries were translated into Dutch.[394]

Physicists on the one hand would have enjoyed this public attention for their field. On the other hand, they tried to control as much of the dissemination of relativity as they could in order to protect their authority. As already pointed out in chapter four, this led to a clear conflict of interest, as scientists tried to enhance their legitimacy by increasing their visibility, but wished to avoid public discussion of their work in order to maintain their authority. How could both of these interests be attended to at the same time? This dilemma sheds light on the motives behind both Einstein's appointment in Leiden and the stream of publications aimed at popularization of relativity. Einstein's presence in Leiden of course created support *and* deference for research on relativity, as Einstein, as its creator, remained the main authority on relativity. Needless to say, Einstein's presence also increased the visibility of Leiden physics. The popularization of relativity can also be considered to have served both the aims of gaining support and retaining authority. Scientists tried to 'force' the public to accept the expert point of view by lecturing over and over again on Einstein's theory. When others tried to debate the value and interpretation of relativity, Van der Waals and Fokker would immediately respond, at times with vigorous comments. Their reviews shared one striking idea, namely that non-experts lacked competence to engage in discussions about the meaning of relativity, as they did not have proper mathematical knowledge. Ironically, when a simple exposition of relativity was published, Van der Waals would on the other hand assert that it was a shame that it did not engage with interpretational issues. In order to write a balanced account on relativity, one thus had to be capable in both mathematics and metaphysics. To put it differently: only expert physicists had the necessary expertise to provide such an account.

How did 'the public' react to this 'diplomacy of popularization' of the Dutch physicists? As we have seen in the previous chapter, the average enthusiast was not very much interested in the exact interpretation of relativity. The general public was mainly interested in science because of its cultural value, and was therefore happy to accept the views of the authorities. Physicists were eager to supply some information on relativity, as it would enhance their visibility, but would not threaten their role as experts: physicists tried to present relativity without invoking discussion. This, however, would not work, as other groups were in fact interested in such discussions. Those who considered themselves capable of understanding science because of a background in philosophy, science, or engineering, did engage in debate with scientists.

The interference of philosophers and philosophical dilettantes with debates on relativity should be clear by now. Both scientists and philosophers claimed that they were the ones most competent to decide on the value of relativity in metaphysics and worldviews. What we have seen was ultimately a debate between physicists and philosophers on the boundaries of physics: what sort of claims could be made on basis of science, and at which point would one have to invoke philosophy? Besides 'philosophical critiques', most other amateur reactions to relativity were straightforward popularizations of Einstein's theory. What was the role of these works, and what motive did their authors have? In general, these works were written by enthusiasts who were involved in science writing, such as students or high school teachers. As I have argued,

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[393] See e.g: Van de Well, "Het relativiteitsbeginsel" (1918); Van Tongeren, "Het relativiteitsprincipe", "Onze Ruimte"; Van der Waerden, "Over Einstein's relativiteitstheorie"; Borgesius, *De Relativiteitsleer*; Heukels, *De Relativiteitstheorie*; Verrijp, *De Relativiteitstheorie*. All of these publications, when they did engage with interpretational issues, emphasized the empirical side of relativity. In general, they argued that the theory was right because it described the phenomena correctly.

[394] See for instance Beer, *De Relativiteitstheorie*; Nordmann, *Einstein en het heelal*.

there certainly was a market for such works in the Netherlands. Apart from enthusiasm, the main reason for engaging in popular science was probably personal gain. As Bowler has shown throughout his analysis of popular science in Britain in the early twentieth century, financial imperatives were often important motives behind popular work written by amateurs.[395] Besides that, publishing a popular exposition of the omnipresent theory of relativity of course also increased the visibility of a science writer.

In general, I would say that the role amateur popularizers played in the reception of relativity was not very significant. Scientists themselves too regularly published popular expositions of relativity, and especially amateur accounts that included technical descriptions were often very similar to expert expositions. Amateur popularizers seemed just to have anticipated a growing demand of scientific knowledge. The experts probably welcomed amateur writers: as we have seen, the latter would generally show deference to the experts, and would not engage in debates on interpretational issues. Instead, they stressed the empirical character of relativity.

To come back to the discussion about the use of popular science in order to constrain participation of certain groups: I would rather argue that in the case discussed here, scientists in fact did try to *exclude* certain groups from partaking in discussions about the interpretation, meaning, and limits of relativity theory. The negative effects of exclusion argued for by Topham, the fact that exclusion would harm economic interest of popularizers and that it would eliminate amateurs as possible workforces, would not have been important to Dutch theoretical physicists. Even though financial incentives played an important role for scientists to popularize their work in many other countries in the first decades of the twentieth century – this has for instance been documented for Sweden and Britain[396] – and we have seen that for instance Ehrenfest could use the extra income provided by popular work,[397] Dutch scientists in general received a generous salary. In fact, as I have argued, this was probably a main argument for Einstein to accept his call to Leiden.

Possible amateur workforces would have been even less important to the Dutch physicists. Where, as Topham argues, amateur participation in fact did play a role in nineteenth century popular science, especially in observational disciplines such as botany and astronomy, modern theoretical physics in fact reinforced the growing gap between science and the public, as is justly argued by Bensaude-Vincent. By the 1920s, increasing professionalization and specialization in the sciences had created an atmosphere in which knowledge was negotiated within a small circle of experts. The authority of non-professionals outside of that sphere had by then been largely obsoleted, as can also be concluded from Bowler's study on popular science in Britain.[398] This situation seems to contrast with predominant ideas in recent studies on science and the public. As I have discussed in the introduction, it has been argued over and over that the traditional idea of popularization as a top-down dissemination of knowledge from science to the public disregards the influence the public has on popular science. Nonetheless, this exclusion in fact happened. As Milena Wazeck has shown, it was one of the main reasons for the vehement anti-relativity attacks in Germany; Wazeck certainly does pay attention to public influences on the popular reception of science. However, as has been recently argued in connection to Bowler's account, the fact that there existed a top-down modus of communication between science and the public does not mean that popular influences were not important: in the British

[395] Bowler, *Science for All*.
[396] For Sweden, see Kärnfelt, "Popularization of Astronomy", for Britain, see Bowler, *Science for All*.
[397] As is discussed on page 39, see also Hollestelle, *Paul Ehrenfest*, p. 189.
[398] Bowler, *Science for All*.

case, this top-down communication seems not only to have been based on the wishes of modern scientists, but also on the expectancies of early twentieth century public.[399]

From what we have seen in the last chapters, the same seems to apply to the Dutch reception of relativity. The general public in the Netherlands was keen to keep up with recent scientific development and acquire some knowledge about relativity. Science and its practitioners were held in high regard, also because of the national prestige they brought about. In the Netherlands, non-academics did not challenge the status of scientists, as they in fact did in Germany. Interesting in this respect is also that in the Netherlands, the demarcation between experts and the public was not as much aimed at excluding laymen in general, but academics from other disciplines more specifically. Exclusion of the general public had already been taken care of; the general public for some reason was just not interested in negotiating scientific knowledge with the experts. In professionalized and well-funded Dutch academic culture, motives such as generating extra income from popular accounts or public participation were considered unimportant. Instead, what was at stake for theoretical physicists was state funding. The best way to attain this, was to emphasise the importance and authority of their discipline. Before I will relate the Dutch public reactions to relativity to receptions of Einstein's work in other countries, I will shortly discuss another section of public reactions in the Netherlands, one that has been claimed to be particular to the Dutch case.

Einstein, Pillarization, and religious reservation

Having discussed the most important debates and the motives for engaging in the public reception of relativity, I would now like to return to the first claim of Henk Klomp's *De relativiteitstheorie in Nederland*. Klomp contends that for certain groups, and especially for "the old order", a negative attitude towards relativity was coupled to the wish to conserve authority and prestige.[400] To substantiate this claim, Klomp shows "that leading intellectuals of the cultural and academic establishment considered relativity theory a threat to [...] their ideological principles" and "discusses the influence of social struggles on the reception of relativity theory",[401] that is, the consequences of the pillarization and democratization. Klomp analyses reactions to relativity of what he considers leading figures of several groups in Dutch society. These include for instance Heymans for the cultural establishment, and Mannoury for the Socialists. After this survey Klomp argues that "the conclusion imposes itself that there was a certain relation between perspectives on relativity theory and attitudes to social order."[402]

Klomp's point in the end boils down to the idea that reactions to relativity theory were to some extent a reaction to the influence of the pillarization. That this is true 'to some extent' can also be concluded from the survey of newspaper articles I have presented in the previous chapters. This, however, is only natural, as these newspapers would always take the primary interests of their audience into account, whether they reacted to relativity, science in general, or anything else. We have seen for instance that *Het Volk* and *De Tribune*, two socialist newspapers, in general would not report much on Einstein or relativity theory, but that when they did, they

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[399] Schmalzer, "Popular Science" p. 594.
[400] Klomp, *De Relativiteitstheorie*, p. 2.
[401] *Ibid*., p. 13. "[we laten zien] dat gezaghebbende intellectuelen van het culturele en wetenschappelijke estblishment de relativiteitstheorie als een bedreiging zagen voor hun [...] ideologische uitgangspunten", and "[hoofdstuk vier] behandelt de invloed van de maatschappelijke strijd op de ontvangst van de relativiteitstheorie".
[402] *Ibid*., p. 118. "De conclusie [dringt] zich op dat er een zeker verband is geweest tussen de zienswijze op de relativiteitstheorie en de houding ten aanzien van de 'maatschappelijke orde'".

where quite positive. Besides that, they strongly protested anti-Semitic attacks on Einstein. Socialists in general were enthusiastic about science, and seemingly considered Einstein as an example of the impartial, objective scientist. Of course, Einstein's alleged socialist sympathies would have played a role in that. A popularization of relativity that appeared in *De Socialistische Gids* and was written by the student B.L. van der Waerden, who would later become an influential mathematician and historian of mathematics, was similarly enthusiastic about relativity. Van der Waerden used ample room to show why he thought the most frequently used metaphysical arguments against relativity were not decisive.[403] The Jewish *Nieuw Israëlietisch Weekblad* showed an even more obviously coloured 'reception': it only reported on Einstein and relativity when they were under attack of anti-Semitic elements. Of course, this was a consequence of the newspaper's extensive coverage on anti-Semitism. As soon as Einstein or any other important figure with a Jewish background came under attack, the *Nieuw Israëlietisch Weekblad* would surely pay attention to that person.

Coverage on Einstein and relativity was thus certainly influenced by religious and ideological denominations. However, as I have argued in the introduction, this does not necessarily mean that ideas on relativity or science showed fundamental differences between distinct groups: a large part of these differences is of course only rhetorical, and does not reflect a particular stance towards relativity. Not the fact *that* the pillarization has had impact on the reception of relativity, but the question *how* it influenced the reception is important. To answer that question, we need to analyse what motivated members of certain groups to reacted differently to the theory than others. As I have already shown in the introduction, several authors have argued that for natural scientists themselves, the pillarization did not play a significant role in the interwar period. Besides testing that idea, this section will also show how public appreciation of science differed between the 'pillars'.

In order to do so, this section will discuss several reactions to relativity theory that appeared in a specific type of media, namely journals with an outspoken religious background. These include for instance cultural journals such as the Catholic *Studiën* and *De Beiaard*, and the Reformed *Stemmen des Tijds*. The fact that articles published in such titles invoked religious and theological points of view, even when they discussed a topic as relativity, is hardly surprising. In order to balance these accounts, I will also shortly discuss some reactions to relativity with a specific but less distinct religious background. In this section I will focus specifically on arguments used by the authors to defend their own interpretation of relativity. How did they integrate relativity into their own epistemologies, and how did they employ relativity to reinforce their own ideas? I will pay less attention to differences between these authors. The way in which these authors presented relativity does show significant differences, and so does the quality of their discussions. In the end, however, these differences do not pertain directly to the characteristics of 'religious responses' to the theory of relativity, which I will try to identify here.

The three main religious denominations in the Netherlands in the period under consideration were Dutch Reformed *(Nederlands Hervormd)*, Catholic, and Reformed *(Gereformeerd)*.[404] Around 1920, the Dutch Reformed Church was the largest and most mainstream denomination in the Netherlands, and many leading intellectuals in the interwar period were associated with it, including for instance Kohnstamm and Van der Waals. Because of that, one can hardly expect the 'Dutch Reformed reception' of relativity to have deviated from

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[403] Van der Waerden, "Over Einstein's relativiteitstheorie", in particular pp. 66-68.

[404] On the pillarization and its influence of Dutch society in the interwar period, see for instance, Kruijt, *Onkerkelijkheid*, Lijphart, *Politics of Accommodation*, Bosmans, "Maatschappelijk-politieke leven".

that among for instance Liberals.[405] This is not the case for the other Protestant group. The Reformed Church had been founded in 1892 by Abraham Kuyper. Kuyper, twice prime minister in the Netherlands, had also founded the Free University in Amsterdam which had a distinct Reformed outlook. As discussed in the introduction, the Free University did not yet have a science department in the 1920s, but some of its theologians actually became involved with relativity theory, as we will see in a moment.

An interesting figure here is Johannes Kuenen, whose father Abraham Kuenen had been an important Protestant theologian in the nineteenth century. Johannes, the professor of physics in Leiden and author of an influential popularization of general relativity in 1917 we have met before, was also involved with theology, and especially with the relation between science and religion. In his 1908 lecture "Natuurwetenschap en Godsdienst" (Science and Religion), Kuenen asserted that the "existing and rather widespread idea" that science and religion would be incompatible was contrary to his own convictions.[406] "It is true, science contradicts many religious convictions *[geloofsovertuigingen]*" he further stated. But, whenever a conflict would arise, these religious convictions "must disappear definitely, or be explained in another, symbolic way."[407] The crux of Kuenen's argument was a fundamental distinction between religious *(godsdienstige)* and theological beliefs. Science could only affect theological beliefs, not those ideas that were key to religious belief. Science would never be able to capture a full description of reality, as it did not include knowledge about the spiritual. Subjective consciousness was an essential part of reality for Kuenen, and in order to understand it, moral and religious convictions were necessary elements of any worldview.[408] In his 1917 article on relativity, Kuenen likewise stressed the legitimacy of concerns from outside the scientific sphere. According to Kuenen, it was important that common sense would be united with scientific conceptions. This of course was a reference to the relativity of simultaneity, which Kuenen did not endorse. His reservation about the 'relativistic conception', became evident in his final sentence. Kuenen asserted that when a way could be found to interpret general relativity in a more Lorentzian manner, this would "certainly in general be welcomed as a relief".[409]

Kuenen's 1908 assertion that there was a widespread idea that science and religion were in conflict is also supported by Barbara Allart's study of nineteenth century popular science in the Netherlands. As Allart argues, both Catholics and Protestants had tried to develop a Christian science in order to counter scientific materialism. Adherents of orthodox groups clearly *did* see science as a threat in the nineteenth century, while those groups designated by Allart as Liberals and Socialists used science to elaborate on their striving for social progress. Naturally, especially biological and geological theories about the origins of mankind and the age of the earth became subject of popular discussion. Just as in the case of relativity, public debate on those issues became quickly related to debates on worldviews, and subsequently to political and philosophical issues. As in the debates discussed in the previous sections, the limits of science were of key importance in the nineteenth century.[410] Even though the role of science was determined by its relation to other epistemologies, and was subordinated to those

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[405] Only a small percantage of the Dutch population had no religious denomination around 1920. However, a significant part of the Dutch elite of that period has often been classified as liberal rather than Dutch Reformed.
[406] Kuenen, "Natuurwetenschap", p. 236.
[407] *Ibid*., p. 236.
[408] *Ibid*., in particular pp. 242-246.
[409] Kuenen, "Relativiteitstheorie", in particular p. 123.
[410] Allart, *De wetenschap*.

epistemologies by certain groups, Allart nonetheless argues that, generally, each 'pillar' reacted positively to science.[411]

This is not the case in Klomp's dissertation. According to Klomp, many Reformed writers reacted reservedly to the theory of relativity. However, Klomp asserts, Reformed intellectuals still did not react as negative as some Catholics. Klomp relates this Catholic reluctance to accept relativity to the socially subordinate position of Catholics in general. As Klomp claims, prestigious positions in government and higher education were in general reserved for Liberals or Protestants.[412] However, the social marginalized position of Catholics, contrary to what Klomp claims, was in fact far less pronounced during the interwar period than in had been in nineteenth century. The 1917 implementation of universal suffrage had brought political power to Catholics, who made up around 35 percent of the total population during the 1920s.[413] In the nineteenth century, only a minority of Catholics had been eligible to vote, but, during the entire interwar period, the most important Catholic party was not only the largest party in Dutch parliament, it was also continuously part of the Dutch government. Furthermore, in 1918, Charles Ruijs de Beerenbrouck became the first Catholic prime minister in the Netherlands. There is thus little ground to associate negative Catholic reactions to relativity to a marginalized social position.

Nevertheless, in spite of these developments, Catholics in fact were still underrepresented in science after the First World War, largely due to their previous marginalization.[414] Only two Catholic experts played a significant role in the reception of relativity: Willem Keesom, second in command in Kamerlingh Onnes' laboratory and his future successor,[415] and the prominent Dutch astronomer J.S. Stein. The latter was a former student of Lorentz, and was affiliated to the Vatican observatory.[416] Keesom, in the 1920s a notable physicist in Leiden, but at the same time also an outspoken Catholic, responded to relativity theory in line with other Leiden physicists. As an experimentalist, Keesom did not work on relativity as frequently as for instance Fokker or Lorentz. Nonetheless, in 1921, he lectured on the theory for *De Vereeniging tot het bevorderen van de beoefening der wetenschap onder de Katholieken in Nederland* (Society for promotion of the pursuit of science among Catholics in the Netherlands), as was also reported in the Catholic newspaper *De Tijd*.[417] In this lecture, which was printed in *De Beiaard*, Keesom argued that relativity was "essentially a *physical* theory", subject to observation. As long as observation agreed with relativity, Keesom argued, "its content is independent from any disagreement of opinion and interpretation".[418] Keesom did not discuss interpretational issues in the rest of his article, which was a straightforward presentation of the theory of relativity.

Keesom's statement shows evident similarities with those of for instance Enklaar and Van der Waals. Although he did not go into detail, it seems obvious that Keesom's point entailed that, because of its empirical confirmation, much of the technical content of relativity was

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411 *Ibid*., pp. 284-285.
412 Klomp, *De Relativiteitstheorie*, p. 102.
413 Bosmans, "Maatschappelijk-politieke leven", p. 206.
414 On Catholics in natural science, see for instance Daling, "Pater Stein", in particular pp. 96-97.
415 For Keesom, see Van Delft, *Freezing physics*.
416 Daling, "Pater Stein", Daling discusses Stein as a specific case of the position of Catholic scientists in the Netherlands in the period under consideration.
417 *De Tijd*, July 2, 1921, p. 2, "Wetenschappen".
418 Keesom, "De relativiteitstheorie", p. 187. "[De relativiteitstheorie is] in haar wezen eene *physische* theorie … In zooverre dit laatste [zij kan door observatie getoetst worden] het geval is, en ondubbelzinnige uitkomsten geeft, is haar inhoud dus verder aan alle verschil van inzicht of opvatting onttrokken" (emphasis in original).

beyond doubt. However, this did not imply that relativity, or science in general, was the only source of knowledge on space and time: relativity only pertained to the *physical* interpretation of these concepts. Where Van der Waals would argue that especially metaphysics was also essential in the interpretation of relativity, Keesom presumably would invoke religion. The same held for the astronomer Stein.

According to historian Dorien Daling, 'Father Stein', "the epitomization of science in Catholic circles", held a respectable position in Dutch science, which accorded with his capacities and ambitions.[419] Stein published mostly in the Jesuit journal *Studiën*. His first article on relativity was published in 1920 and opened as follows: "We live in an age of general revolution. The foundations of the old world order are shaken, and we do not know as yet, how a new world order will be constructed from the pumice of destruction. This revolution seems to have affected the sciences too".[420] At first sight, this defeatist statement seems to resemble expressions of some of Einstein's most fervent opponents. For instance Ernst Gehrcke, the main figure in German anti-relativity movements, too argued that social revolutions affected science.[421] Arvid Reutherdahl, Gehrcke's counterpart in the anti-relativity movement in the United States, and an outspoken anti-Semite, asserted: "We are emerging from a period of material and intellectual chaos. Nations have clashed in war. The intellectual world is still in conflict on the fields of knowledge. Never before has the demarcation between intellectual camps been so clearly defined. The meteoric rise of Einstein marks the beginning of this division in the modern kingdom of intellect."[422] Although Stein's statement seems to resemble those of Gehrcke and Reutherdahl, the similarities are only apparent. According to Stein, the revolution only *seemed* to have influenced science: from the rest of his article, it becomes clear that Stein in fact did not believe that relativity theory would revolutionize human thought. He attributed the idea that science was being revolutionized to "extremists". According to Stein it was a misconception that 'the old certainties' had to be abandoned, more moderate points of view were certainly possible.[423]

As the *NRC* also indicated in a discussion of a lecture by Stein, the astronomer, as could be expected from the above, did not accept the relativity of simultaneity.[424] In a later article, the *NRC* even argued that Stein was an opponent of Einstein's theory. It asserted: "Resistance to the theory – also coming from competent people – has not fallen silent yet", with an explicit reference to Stein.[425] Was Stein an opponent of relativity? He did react reservedly to the theory, and on several occasions argued that empirical evidence in relativity's favour was as yet not thoroughly convincing; he however did feel that the theory, especially its mathematical formulation of gravitation, had much to offer for science, and therefore accepted it as a "working hypothesis".[426] Relativity of simultaneity nonetheless was in contradiction with common sense, as the true meaning of 'simultaneity' appeared to be very clear to Stein.[427] Stein thus dismissed the relativist interpretation, and was more inclined to accept Lorentz' ideas, which he cited

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[419] Daling, "Pater Stein", in particular pp. 99, 113-114.

[420] Stein, "Einstein's theorie: I", p. 385. "Wij leven in een tijd van algemeene omwenteling. De oude wereldorde is tot in haar grondvesten geschokt, en wij weten nog niet, hoe een nieuwe orde zal worden opgebouwd uit de puimen der verwoesting. Die revolutie schijnt ook overgeslagen te zijn op het terrein der natuurwetenschappen."

[421] On Gehrcke's statements on that matter, see e.g. Van Dongen, "Mistaken Identity", pp. 165-167.

[422] Arvid Reuterdahl, "The academy of nations – Its aims and hopes." *The Dearborn Independent*, January 7, 1922, p. 14. Cited in Wazeck, "Marginalization Processes", p. 182.

[423] Stein, "Einstein's theorie: I".

[424] *NRC*, December 11, 1920, p. 10, "Wetenschappelijke Berichten";

[425] *NRC*, November 5, 1921, p. 3, "Wetenschappelijke Berichten".

[426] Stein, "Einstein's theorie en de feiten"; "Hoe staat het met de relativiteitstheorie?".

[427] Stein, "Einstein's theorie: II", pp. 488-489.

frequently.[428] Relativity gave new and useful mathematical formulas, but, Stein argued: "it leaves us in the dark about the mechanisms of the forces of nature".[429] Although he clearly had doubts about the theory, considering Stein an opponent of relativity does no justice to the nuances of his reception of the theory. He was not critical towards the mathematical content of the theory; his criticism affected its philosophical side only. Especially offensive to him were overly realistic interpretations of such entities as four-dimensional spacetime. In 1926, Stein argued that such ideas, as proposed by the British scientists Jeans and Eddington, where "fantasies". He however let his readers know that even if one would not endorse such "four-dimensional extravagancies", one could still be an admirer of Einstein's work.[430]

Although they might or might not have had different reasons for their reluctance to accept relativity, what we see from these two Catholic experts does not diverge significantly from what other physicists would say about relativity. Like for instance Lorentz, Van der Waals and Kuenen, they felt that Einstein's new formulation of relativity had much to offer, but were hesitant to give too much epistemological weight to the 'relativist interpretation' of the theory, and especially to the relativity of simultaneity.

The Catholic physicist J.H. Tummers, who in 1926 would be appointed as lecturer in philosophy of mathematics and physics at the Catholic University of Nijmegen,[431] also questioned the relativity of simultaneity in an article in the *Tijdschrift voor Wijsbegeerte* in 1922. Tummers, teacher at the HBS of the town of Venlo, acknowledged the "mathematical necessity" to extend the principle of relativity from inertial frames to accelerated ones. But, according to Tummers, this mathematical necessity did not prove the extension of relativity to be philosophically acceptable.[432] Tummers, like many other philosophers we have seen, argued that one could accept relativity while retaining the old conception of time: one just had to separate the mathematical symbol that represented time from actual philosophical time. Every statement on simultaneity required time-measurements, and as Tummers asserted, because of the limited speed of light, we, as humans, were not able to make statements on absolute simultaneity. But, he continued, one could as well argue that not time itself, but only time-measurements depended on the observer's point of view. Surely, we could think of beings that did not need light rays as messengers (Tummers refrained from explicitly referring to God). Such beings in fact could make claims about absolute simultaneity. Therefore, not the very idea, but only the physical conception of absolute simultaneity was impossible.[433]

Tummers elaborated on these ideas in 1924. As Tummers argued, Einstein had admitted that the two postulates of special relativity seemed to contradict each other. Where Einstein had argued that this was in fact not a paradox, Tummers thought otherwise. According to Tummers, Einstein had not been able to prove logically proven that the two postulates of special relativity were consistent. Because of that, Tummers continued, the factual contradiction remained, and relativity of simultaneity, which followed from Einstein's postulates, was untenable.[434] Tummers' book was reviewed by Stein, who again gave a nuanced response. Stein argued that although he agreed with Tummers that there was nothing strange about the idea of absolute

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[428] See e.g. *Ibid*., in particular pp. 491-495.
[429] *Ibid*., p. 500.
[430] Stein, "Phantasieën", in particular pp. 200-201.
[431] Klomp, *De Relativiteitstheorie*, p. 104.
[432] Tummers, "Een wijsgeerig onderzoek", p. 263.
[433] *Ibid*.
[434] Tummers, *Die spezielle Relativitätstheorie*. For a short summary of his main points, see Tummers, "De niet-contradictoriteit", in *Physica*, 10, 1930. In the same issue, see also A.D. Fokker, "Review Tummers", pp. 139-140; "Antwoord aan dr. Tummers", pp. 264-266. Fokker, as he had done before, reacted with disdain, and referred to Tummer's work as "regretable".

simultaneity, Tummers had been wrong in his claim that Einstein himself had wanted to show that simultaneity was a relative concept. According to Stein, Einstein was only interested in the physical side of his theory; Einstein had claimed himself that relativity had no influence on pure philosophy.[435] Although Einstein had in fact made remarks in that direction,[436] he in all likelihood would not have agreed with Stein. Einstein would certainly not refrain from letting relativity influence philosophy, as we have for instance seen in his argument with Bergson.

The reactions we have seen so far can hardly be described as opposition to relativity. Although there is something to be said for considering Tummers' later work as an attack on relativity, his 1922 article certainly was not. Klomp's claim that in general most negative reactions to relativity came from Catholics, is however mainly based on two other authors: Willebrordus Tombrock and Evart van Dieren. As these were both marginal figures and were widely met with contempt, a short note on both will do. Tombrock and Van Dieren are in no way representative for the Dutch reception of relativity, and there has been no wider support for their ideas that I am aware of. Tombrock, a Catholic and a chemist, as already pointed out, authored several works criticizing modern science. His targets included relativity theory, quantum mechanics, and other physical theories on elementary matter.[437] Although he probably had some followers, his work in general can be considered marginal. His influence on the reception of relativity has presumably been negligible. Van Dieren, who in contrast to what Klomp has stated was not a Catholic but instead a member of the Dutch Reformed Church, was a similar polemical figure. His virulent works were not in the least aimed at relativity only; his main targets included such topics as socialism, bacteriology and the theory of vitamins.[438] His status as agitator was discussed in a review of his work in *Het Vaderland*, which argued that his oeuvre in general and his critique on relativity in specific lacked scientific depth.[439]

The origin of Klomp's confusion about Van Dieren's religion might have been a review of the latter's book on relativity published in the journal *De Katholiek*. The author of this review, W. Jacobs, had actually already published his own popularization of relativity in De Katholiek in 1922. In his first article, Jacobs stated that although some considered relativity, the theory "of the Berlin and Leiden professor A. Einstein", a serious threat of the natural sciences to the Christian worldview, it was in fact not as revolutionary as had been claimed.[440] With explicit reference to Stein, Lorentz, and Kuenen, Jacobs argued that relativity did not entail psychological relativism. Moreover, it was as yet not at all certain whether even "physical relativism" would be a necessary consequence of the theory of relativity, according to Jacobs. Physical relativism would be an outcome of the "reduction of reality to the experimentally ascertainable";[441] however, Jacobs argued, inner experiences were also a component of reality. To protect science from positivism as well as from Kantian phenomenalism, one had to invoke scholasticism, which in fact did take account of those inner experiences. Although he thus argued for an alternative interpretation, Jacobs was in general quite positive about relativity, and, at the end of his survey,

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[435] Stein, "Einstein's relativiteitstheorie en de logica".

[436] There are multiple occassions were Einstein downplayed the influence of relativity on human affairs. For instance during his 1921 trip to Britain, Einstein famously remarked to the Archbishop of Canterbury that relativity had no nothing to say about human morale, as it was "purely abstract science". See e.g. Price, *Loving faster than light*, p. 35.

[437] On Tombrock and Van Dieren, see Klomp, *De Relativiteitstheorie*, pp. 103-104. I thank Friso Hoeneveld for pointing me to the oeuvre of Tombrock and his help in finding material for my research in general.

[438] For his attack on relativity, see Van Dieren, *Historisch-idealisme*. On Van Dieren and his resistance to modern science in general, see Bos, *Evart van Dieren*.

[439] *Het Vaderland*, June 9, 1923, p. 11, "Over Einstein. Nieuwe uitgaven". See also Bos, *Evart van Dieren*, pp. 241-244.

[440] Jacobs, "Over relativiteitstheorie", p. 1.

[441] *Ibid*., p. 16.

expressed the hope that Einstein could develop his theory further so that the human race could come closer to the One Truth.[442]

In his subsequent review of Van Dieren, Jacobs similarly argued that Van Dieren's attack on relativity was grounded on a misconception. Van Dieren had based his criticism on Moszkowski's popularization of relativity, which, as we already have seen, was deemed by many a failed attempt at popularization. Jacobs agreed: Moszkowski's book could not be taken seriously. Instead, Jacobs argued, a better understanding of relativity could be attained by studying the works of Stein and Kuenen. According to Jacobs, Van Dieren should have understood that he himself had been wrong whenever many experts disagreed with his judgement.[443] Besides a Jacobs a review of Van Dieren, Jacobs, with his numerous and admiring references to Lorentz, Stein and Kuenen, here certainly also presented an excellent example of the willingness of the Dutch to ascribe to 'top-down popularization'. Once again, we see that the authority of science was undisputed; only a few critics of relativity would contest expert knowledge.

As was the case for Bolland's attack and Van Eeden's enthusiasm, the opposition of those critics, for instance that of Tombrock and Van Dieren, at times focused on relativity, but in the end pertained to modern science in general. These critics represented a part of the Dutch public that had an aversion to modern science, for whatever reason. As the reception of Einstein's work indicates, this group was rather small in the Netherlands, and their work marginal. Critics of relativity mostly *did* support recent scientific development: their criticism centred on interpretational issues. Exactly this attitude can also be observed in a number of publications that appeared in the Reformed *Stemmen des Tijds*, which I will discuss briefly now. As we will see, the authors of these articles praised Einstein while denying relativity's authority to invalidate their own religious and theological knowledge claims. Similarities with especially Catholic reactions to relativity are evident and overwhelming.

A first article on relativity appeared in *Stemmen des Tijds* mid 1919, before the confirmation of gravitational light-bending. Its author was J. van Bruggen, a physics teacher who, according to the *Handelsblad*, would lecture on relativity for an assembly of Dutch Reformed preachers from the province of Zeeland in 1920.[444] I have not been able to ascertain whether Van Bruggen was actually a member of the Dutch Reformed Church or the Reformed Church instead. However, as his article appeared in *Stemmen des Tijds*, his audience would have mostly consisted of Reformed readers. Those readers would have been pleased to hear that relativity did not entail a revision of worldviews. Physics was a descriptive discipline according to Van Bruggen, who further argued, with a reference to Poincaré, that measurements had only relative value. The scientific method picked out measurability as the only criterion of reality. Therefore, it did not affect metaphysical conceptions. When the scientific method was in fact used outside of science this would only lead to mistakes. According to Van Bruggen, this surely was the case with positivistic science. The only possible conclusion was that science had to be radically separated from metaphysics.[445]

Like many other authors, Van Bruggen downplayed the importance of scientific knowledge on worldviews. However, Van Bruggen was much more radical than other authors, as he claimed that science had *nothing* to say about philosophical concepts. But, because of his emphasis on relative movement, Einstein had shown that this in fact was exactly the case, as Van Bruggen argued: "a science that picks measurability as its only criterion of reality, by that a

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[442] *Ibid*.
[443] Jacobs, "Een geruststellend woord".
[444] *Algemeen Handelsblad*, June 18, 1920, p. 13, "De Zeeuwsche Hervormde Broederkrans".
[445] Van Bruggen, "Moderne natuurwetenschappelijke denkbeelden".

priori excludes all metaphysical factors (including the mistaken ones)".[446] Instead of to science, questions of worldviews belonged to the sphere of religion. This enabled Van Bruggen to avoid any conflicts between scientific and religious knowledge: these two pertained to strictly separated fields. Therefore, science and religion could only enforced each other, as long as proper attention was paid to the boundaries between them.[447] Instead of rejecting relativity, Van Bruggen clearly cherished the theory, as it helped him in defending his own epistemological views.

Although another article in the *Stemmen des Tijds* argued that physics in fact did include metaphysics, its underlying ideas restate those of Van Bruggen almost completely. In 1922, D.H.Th. Vollenhoven, not to be confused with the legal scholar Cornelis van Vollenhoven, argued that the positivistic conception of science tried to reduce physics to mathematics. Instead, according to Vollenhoven, physics had to include philosophical and theological influences. Vollenhoven thus did not separate science from philosophy and religion. Instead, he argued that positivistic modern science did not include metaphysics, while a true science in fact would do so. Just like Van Bruggen, Vollenhoven argued that in order to arrive at a true understanding of the world, both science and metaphysics had to be involved.[448]

Vollenhoven presented his article on relativity as a review of Van der Waals jr.'s *Over den Wereldaether*, which in fact had only discussed relativity very briefly. In his earlier work, Vollenhoven, philosopher at the Reformed Free University, had subscribed to the university's aim of providing a "Christian explanation of the possibility of knowledge". Vollenhoven himself especially worked in the foundations of mathematics and physics.[449] In 1922, he specifically discussed Einstein's inaugural lecture in Leiden. According to Vollenhoven, Einstein there had acknowledged the 'gravitational ether' as a real physical entity. Vollenhoven argued that this closed a "rupture", and led to an "increase in the inner consistency of the new physics". Where Lorentz' work had already closed a first rupture between mechanics and the electromagnetic ether, Einstein had now closed the gap between the theory of light and gravitational action at a distance.[450] Initially, Vollenhoven argued, Einstein's rejection of the ether had seemingly led to a positivist revolution in science. The "positivists among physicists" aimed only at simple mathematical descriptions of phenomena, and therefore tried to reduce physics to mathematics. Vollenhoven, as an "epistemological realist" objected to this reduction, and so did Einstein after he had acknowledged the reality of the ether, Vollenhoven asserted. He further affirmed that the demarcation between physics and mathematics had been reinstated, and that the positivist revolution that had tried to reduce physics to mathematics had been put to an end.[451]

Interesting is that while the articles by Vollenhoven and Van Bruggen show a clear understanding of the basic concepts of relativity, they still arrived at conclusions similar to those of authors who lacked such an understanding. A similar demarcation between science and metaphysics as was constructed by Van Bruggen was for instance also made by both Jacobs and Tummers, even though they showed clear confusion about the theory.[452] The same holds for experts with an outspoken religious background: Kuenen and Keesom too emphasized the

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[446] *Ibid*., p. 387. "Een natuurwetenschap, welke de meetbaarheid tot eenig werkelijkheids criterium kiest, sluit daardoor a priori alle metaphysische factoren (de slechte evenzeer) uit."
[447] *Ibid*.
[448] Vollenhoven, "De toeneming der logische geslotenheid".
[449] Klomp, *De Relativiteitstheorie*, p. 98.
[450] Vollenhoven, "De toeneming der logische geslotenheid", in particular pp. 130-134.
[451] *Ibid*.
[452] Klomp for instance has classified Tummers' article under "confusions about the theory of relativity", along with among others the articles by Van Dieren and Wigersma. See Klomp, *De Relativiteitstheorie*, p. 232.

boundaries between science and other forms of understanding. Similarly, philosophers objected to the intrusion of their sphere of knowledge by relativity. Although there are clear differences in how these authors presented relativity, their criticism of the theory thus shared several essential characteristics. Like many experts, these critics accepted the authority of Einstein's mathematical formulation of gravitation, but reacted reservedly to the interpretation of the theory. In general, they would argue that the 'relativist interpretation', which in almost all cases referred explicitly to the relativity of simultaneity, was *not* an inevitable consequence of the Einstein's theory.

Thus, both philosophically and religiously inspired criticism of relativity in the end boiled down to a defence of the critic's own epistemology. What these writers reacted to, was a suppression of one their own claims on the foundations of knowledge. Not only people like Stein and Jacobs, but also philosophers such as Wigersma and Heymans protested the growing influence of scientific knowledge and the exclusion of arguments based on what they would call 'common sense' or 'evident truths'. What we see here is that critics of relativity shared a common ground, rather than differences based on positions in society, levels of scientific knowledge, or 'pillarized' ideologies.

As we have seen, this also holds for newspapers coverage. On a direct level, pillarized ideologies did steer media handling of Einstein. But, although coverage was coloured by ideological differences, contrasts between authors of distinct pillars were not as essential as certain similarities in their assessment of relativity. Neither underlying motives to react to the theory nor the content of the actual reactions differed significantly among the pillars. Instead, ideologies 'filtered' coverage in a rather predictable way: newspapers for instance reported only on Einstein whenever it would appeal to their particular audience. Reactions to relativity by Catholics or Socialists were not characteristic of the Catholic or Socialist reception of relativity. Instead, they were characteristic to Catholic and Socialist press in general. As has been noted before in the case of both Reformed and Catholics scientists,[453] science was not very much influenced by pillarization in the interwar period, and, as we have seen here, neither was the appreciation of science among different publics. Also in Reformed, Socialists, and Catholic circles, scientists were held in high regard. Although their newspapers might give less attention to science than for instance Liberals, these newspapers did not react critically on science. Furthermore, each of these groups had its own scientific heroes, as we have seen for instance in the case of Stein, who seemed to be Jacobs' main authority on relativity next to Lorentz.

Thus, the Dutch reception of relativity in a sense rose above the social fragmentation. Whatever the ideological background, the foundation of their criticism of relativity theory was equal: relativity theory was a useful physical theory, but was not to intervene with other philosophical or religious worldviews. And although Einstein's mathematical genius was praised, 'relativist metaphysics' was in general considered to be flawed, or was interpreted in such a way that it could be reconciled with other epistemologies. Criticism of relativity basically boiled down to a defence of epistemological views, regardless of whether these epistemologies centred on the Platonian idea of absolute knowledge, Hegelian philosophy of knowledge, or Christian doctrines. Nonetheless, these reactions did not entail a rejection of relativity, only of its supposed metaphysical implications.

[453] Respectively Flipse, "Science-Religion Conflict" and Daling, "Pater Stein".

Criticism, marginalization and the relations between science and the public

In order to put the Dutch reception into context of more general ideas on the reception of relativity and receptions of science in general, it is useful to compare my analysis with what has already been written about public receptions of relativity internationally: how does this story about the Netherlands fit in with the existing body of literature? Although current literature has a predominant focus on outspoken opponents of relativity, the motives of these people on the fringes on science are very important for a thorough understanding of the role of science. Comparing the role played by such critics in the Netherlands to their situation in other countries can therefore shed much light on public perspectives on science.

Until recently, studies on opponents of relativity have mainly focused on their political motivations.[454] Because of that, as Milena Wazeck has argued in her dissertation *Einsteins Gegner* in 2009, too little importance has been attached to epistemological criticism of Einstein's theory.[455] Since 2009, several authors have tried to understand relativity's critics by combining epistemological and political objections in their studies,[456] while emphasizing the notion of 'marginalization'.[457] Especially Einstein's German opponents seem to have been motivated by both scientific and social marginalization. As Wazeck has clearly shown, the two groups that engendered most critics in Germany were the *Welträtsellöser* and empirical physicists. The former, a group of non-academics, perceived to be marginalized by professional, institutionalized science. German empiricists on the other hand felt that they were being sidelined the growing influence of their theoretical colleagues in German societies and universities.[458] Here, I will argue that neither of these two marginalization processes can explain why Dutch critics of relativity became involved with the theory in the first place.[459] Subsequently, I will propose other motives for their critical discussions of relativity.

In the Netherlands, the main source on the role of critics of relativity so far has been Henk Klomp's dissertation. Similarly to what we have seen here, Klomp has observed that a common ground between Dutch critics of relativity was that they perceived the theory to compromise "the principle of obviousness". According to Klomp, "conservatives such as Heymans, Vollenhoven" and many others we have encountered here, protested relativity's perceived attack on the idea that the foundations of knowledge have to be obvious.[460] Thus, in his evaluation of the Dutch reception of relativity, Klomp also arrives at the conclusion that most reactions to relativity can be interpreted as attempts to defend the authors' own prestige and epistemology. However, as has been discussed, Klomp relates this defence of epistemologies to a conservative political point of view and striving for preservation of the social status quo.

At first sight, the studies of Wazeck and Klomp seem to form a coherent story of the reception of relativity. As Jeroen van Dongen has argued, both in the Netherlands and in Germany, the reception of relativity was strongly coloured by local political and cultural

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[454] See e.g. Goenner, "Reaction to Relativity"; Rowe, "Einstein's Allies"; Van Dongen, "Reactionaries and Einstein's Fame"
[455] Wazeck, *Einsteins Gegner*.
[456] See e.g. Van Kimmenade, *Resistance*, Van Dongen, "Mistaken Identity".
[457] In particular Wazeck, "Marginalization Processes".
[458] Wazeck, *Einsteins Gegner*.
[459] This slightly contrasts with what has been argued in an earlier account that was written in a preliminary stage of this thesis, see Van Besouw & Van Dongen, "Reception of relativity". In particular, on p. 102, it is argued that social marginalization in fact did play an important role in Dutch reception. This article has however mainly been based on newspaper coverage and the critics of relativity as described by Klomp. My own extended studies of those critics have further developed my ideas on this point.
[460] Klomp, *De Relativiteitstheorie*, p. 222.

contexts.[461] Now, is the Dutch reception really comparable to the reception in Germany, and was marginalization indeed a leading motive for Dutch critics to react to relativity? What did opponents of relativity try to win by publishing their thoughts on relativity, was it their perception of being marginalized?

Considering the case of Heymans, one certainly has to conclude that this is the case for some opponents, as I have argued elsewhere.[462] Heymans, arguably relativity's most interesting critic in the Netherlands, did feel threatened by the theory, and his opposition to relativity can be considered in terms of marginalization to a large extend. By shattering the foundations of his thought, in particular the absolute character of knowledge and the validity of Euclidean geometry, relativity did not only undermined Heymans' scientific oeuvre, but also his political philosophy. This was clearly pointed out to him by physicists as Kohnstamm and Clay, and Heymans thus took a critical stance towards relativity in an attempt to defend his social position.[463] For Dijksterhuis too, relativity might have seemed a threat to his social position as expert on mathematics education. However, as I have argued, Dijksterhuis easily avoided discussion of relativity without; this did not in the least compromise his position as pedagogic expert. In his case, marginalization certainly did not take place.

At this point, it might be interesting to compare the common ground we have observed in critical 'popular' reactions to relativity in the Netherlands to Lorentz' reception of Einstein's theory, as Dutch critics reflected Lorentz' initial reaction to the theory of relativity to a great extend. As has been described by Richard Staley: "It is revealing that […] Lorentz […] made epistemology central to the meaning of the theory but largely independent of the endeavour to create a relativistic physics."[464] Thus, although Lorentz was very much interested in the meaning of relativity and gave much weight to his epistemological preferences in his interpretation of the theory, the fact that he disagreed with some of relativity's main proponents on what would be the most useful interpretation did not cause him to question the validity of Einstein's work. Lorentz was pleased to incorporate Einstein's ideas into his own research, as long as it would help him to further his own physics.

Thus, in general, both Lorentz, the single most important expert in the Netherlands, as well as Dutch critics of relativity welcomed Einstein's attempts to further relativistic physics, but would at the same time disagree with the alleged metaphysical implications of the new physics. Therefore, instead of rebelling against a growing influence of institutional physics, Dutch critics of relativity affiliated themselves with their national academic authorities. Not only Lorentz, but also Kuenen, Van der Waals and Stein were often and approvingly cited when for instance the relativity of simultaneity was contested. Because of that, one cannot speak of marginalization of non-academics by specialized academic science *before* the actual reactions to relativity, nor of a marginalization caused by the theory of relativity itself. Of course, when they published their thoughts and received fervent criticism by actual physicists, the authors of popular critiques on

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[461] Van Dongen, "Mistaken Identity", p. 169. Van Dongen points to German opponents of relativity and internationalist motives for Einstein's appointment in Leiden to substantiate this claim.
[462] Van Besouw & Van Dongen, "Reception of relativity".
[463] Klomp, *De Relativiteitstheorie*.
[464] Staley, "Histories of Relativity", p. 289. It has been argued on basis of Staley's work that Lorentz reaction to relativity can be explained by "the exceptional importance Lorentz gave to epistemology", see Canales, "Twins and Time", p. 250. However, Lorentz certainly did not give exceptional importance to epistemology, as the second part of the above citation already shows. Although I agree with Canales that epistemological differences were at bottom of interpretational disagreements between Einstein and Lorentz (see also Frisch, "Mechanisms"), Lorentz never let his preferred approaches interfere with "the endeavour to create a relativistic physics", as Staley argues. On Lorentz' willingness to set aside methodological and epistemological differences in order to arrive at 'scientific progress', see also McCormmach, "Lorentz, Hendrik Antoon", and page 25 of this thesis.

relativity theory would have felt sidelined. But, even though Fokker and Van der Waals seemed to marginalize them, many critics could point to other physicists, physicists who were thought to be much more important than these two relatively young reviewers.

Although, in the Netherlands too, many 'opponents' of relativity became subject to marginalization at some point after they engaged with Einstein's work, the focus on this marginalization has at some points obscured the real motives for critics to enter debates on relativity in the first place. Especially in the Dutch case, pointing to some sort of social or scientific marginalization does not do the job. As has already been indicated, there were distinct differences between the groups on the 'fringes of science' in the Netherlands and Germany in the early twentieth century. Where the German *Welträtsellöser* held an aggressive attitude towards institutional science, no such hostility was present in the Netherlands. Particularly aggravating to German opponents of relativity was the fact that, at a certain point in time, 'relativists' stopped to answer their criticism, and instead chose to neglect anti-relativists entirely.[465] This too, did not happen in the Netherlands. We have seen multiple polemics between opponents and academic experts such as Fokker and Schouten. And when the number of critiques on relativity increased in 1922 and 1923, so did the number of Van der Waals' reviews.

Similarly to the Dutch case presented here, Astrid van Kimmenade has indicated that in the French reception marginalization did not play a significant role. Although she has actually identified a multitude of non-academic opponents of relativity in France,[466] Van Kimmenade contends that these opponents were not primarily motivated by a marginalization of their scientific or social position. If there had been a genuine marginalization of their position, Van Kimmenade argues, these non-academic would have organized themselves in a united front against relativity and institutionalized science.[467] Although Van Kimmenade admits that her arguments to claim absence of marginalization are not entirely convincing,[468] she at least does show that French anti-relativists were not as fervent and determined as their German counterparts.

However, in the Netherlands, the role played by non-academics was even less important than in France. Interesting in this respect are also the differences between for instance Kortmulder and Enklaar, both affiliated with non-academic education, and Tummers and Polak, who in fact did held academic positions. Kortmulder, philosopher at a military academy in Rotterdam, and Enklaar, author of high school textbooks in chemistry, reacted explicitly positive to relativity theory, while Polak, lecturer at the agricultural academy college in Wageningen, and Tummers, form 1926 lecturer at the recently founded university in Nijmegen, can in fact be considered relativity's main and most important opponents in the Netherlands:[469] the critics *with* an actual academic position reacted much more negative to relativity than those without such a position. This fits in excellently with what we have seen before: the undisputed and unchallenged status of scientists in Dutch public opinion. The fact that, as we have seen, demarcations between experts and non-experts were mainly designed to exclude scientists from other disciplines rather than laypeople in general, can also be connected to this point. Discussions on the interpretation of relativity took place mainly between people who can be identified as academic scientists.

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[465] Wazeck, *Einsteins Gegner*, "Marginalization Processes".
[466] Van Kimmenade, *Resistance*, pp. 122-124.
[467] *Ibid*., in particular pp. 130-131.
[468] *Ibid*., p. 131.
[469] Of course, Heymans and Bolland were the most prominent critics of relativity in the Netherlands. However, Heymans only published his thoughts only once, while Bolland in fact never elaborated on his ideas on the theory. I would argue that especially for Heymans, the designation 'opponent' is too strong.

Therefore, if there was any marginalization in the sense described by Wazeck, it would in all probability be closer to the marginalization of experimental physicists than to that of the Welträtsellöser. Significant anti-academic sentiments were not present in the Netherlands, although we can clearly identify a couple of marginal figures, for instance Van Dieren en Tombrock, as 'opponents of science proper. Marginalization of actual experimentalists however did not take place either, as can for instance be inferred from the unparalleled authority the experimental physicist Kamerlingh Onnes wielded in Leiden, *nota bene* in the presence of such theoreticians as Lorentz and Ehrenfest.[470] Instead, significant opposition to relativity seems to have come mostly from what can be called 'peripheral universities'. As has been described by David Baneke, there certainly were tensions between the actual universities in Leiden, Utrecht and Groningen, and the university colleges of applied sciences in Delft and Wageningen in the early twentieth century.[471] However, as both Schouten and Fokker worked in Delft, it is hardly surprising that there was no critical reaction to relativity there.

Although there were certain tensions between theoretical physicists affiliated with the Leiden group around Lorentz and other academics, I have argued here that marginalization processes similar to those described by Wazeck did not play a significant role in the Dutch reception of relativity. Instead, I believe that we could as well consider criticism on the theory of relativity from another perspective. Because of the fact that marginalization cannot explain the reception of the theory in the Netherlands, I feel that it is no longer helpful to consider Dutch criticism on relativity only as a reaction to a threat. Instead of such a negative description of Dutch critiques, I would like to propose an explanation of their commentaries on relativity in which we can treat these authors in terms more similar or 'symmetrical', to those that have been used when describing the reception of the experts. Instead of focusing on their reaction to the theory,[472] I would like to stress their reasons for acting at all.

For one, I believe that many of the Dutch critics saw reacting to relativity theory as an opportunity to improve their own status and position. A critique on relativity would surely be noted; the theory was of course omnipresent. If we assume that the likes of Polak, Enklaar, Wigersma and Tummers really believed that relativity theory was untenable, they would of course also believe that they could further their own position – primarily their scientific position but through that, also their social position – by pointing out the fallacies of Einstein's work to their colleagues. Considering especially Lorentz' reluctant stance to relativity, the critics could as well have believed there was strong support for alternative interpretations of relativity theory. But besides personal gain, a critique of relativity could also serve to make a case for their own preferred epistemologies or metaphysics, whether that would be for instance Hegelian thought for the Bollandists or a Christian science for Jacobs and Van Bruggen.

As argued before, reactions to relativity shared an essential common ground: they tended to bring relativity in accordance with their own worldviews. To do so, the influence of science had to be limited in such a way that philosophical, theological or even psychological epistemologies could be retained. Instead of categorical rejections of relativity, what we instead see over and over again in the Netherlands is that those who reacted to relativity discussed it in order to reinforce their own points of view. This also becomes clear from the context in which respective authors discussed Einstein's achievements. Where for instance Lorentz would place

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[470] On Kamerlingh Onnes, his tactics, leadership of his laboratory and university politics in Leiden, see Van Delft, *Freezing physics*.

[471] Baneke, *Synthetisch Denken*.

[472] As I have argued in the introduction, there is no need to explain public *attention* to relativity, as it was a logical consequence of extensive popularization. However, this does not explain the particulars of public *reactions* to the theory.

Einstein's theory in the electromagnetic tradition of Fresnel, Maxwell, and Michelson, the mathematician Schouten considered Einstein the successor of the mathematicians Euler, Gauss and Riemann. Likewise, the philosopher of mathematics Kortmulder pointed to contributions of Dedekind and Riemann, while, as we have seen, the philosopher Enklaar used Leibniz, Berkeley, Kant, and Mach to introduce relativity theory. The astronomer Stein instead focused on the empirical side of relativity, pointing to astronomical tests of relativity. Such contexts too, can be considered attempts to enhance the visibility of these authors' own fields of interest.

As has been argued before, both here and in the literature,[473] Dutch criticism on relativity of course was a reaction to modern science, as it was in other countries. But, this does not have to be seen merely as a defensive attitude: in the Netherlands, critics did not only believe that modern science *had* to turn into a different direction, they also considered such a turn a realistic possibility. Preeminent scientists such as Lorentz and Kuenen seemed to advocate what critics considered a more reasonable approach. What we see is that the criticism of relativity theory was influenced to a great extend by the 'moderate' reception of relativity by of Dutch scientists, which is of course easily related to the Dutch self-image of reasonableness. In this, the 'intellectual reception' of relativity is very much related to 'public opinion on the theory, and, once again, witnesses to the undisputed cultural status of Dutch scientists.

One pressing question now remains: how is this extraordinary influence of Dutch scientists on both public opinion *and* on critics on the fringes of science related to ideas on the role of science and scientists in Dutch public opinion, and the actual role played by these scientists? In order to answer these questions, a short comparison with the role of scientists in other countries might be useful, as reactions to relativity from non-academics were quite different there. How can we interpret these differences in the light of distinct non-academic traditions in the Netherlands and those in Germany?

Of course, German *Welträtsellöser* did not spring from nothing. In fact, as has been noted by Wazeck, they were very much inspired by Ernst Haeckel's *Die Weltraetsel*, published in 1899. Haeckel, one of Germany's most prominent intellectuals in the late nineteenth century, in turn stood in a long German tradition of scientists that worked on 'universal theories'. The idea that there was a 'world riddle' to be solved was commonplace among German public in the first decades of the twentieth century; subsequently many of those on the fringes of science developed their own theories.[474] Now, as Wazeck has shown, German opposition to relativity can be understood as a reaction to a threat of modern physics. Not only did relativity frequently conflict with 'universal theories', professionalization of science also threatened the very position of non-academic *Welträtsellöser*. In Germany too, we can clearly see that comments on relativity were very much inspired by local traditions in popular science. In the Netherlands, these traditions were very different. Instead of concentrating on big pictures and universal theories, Dutch scientists emphasized specialized knowledge. Striking in this respect is Kamerlingh Onnes cherished expression 'through measurement to knowledge' (*door meten tot weten*).

This tendency to refrain from big pictures of course resonated strongly with the rational, thoughtful and moderate aspects of the Dutch self-image. These values can also be found in Dutch scientific societies. In general, the period around 1850 is considered a breakpoint in Dutch scientific culture. Where in the first half of the nineteenth century, scientists focused on their position on society and the moral usefulness of science, the second half saw an increasing accent on scientific research and practical usefulness. Instead of universal men of knowledge, scientists

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[473] Klomp, *De Relativiteitstheorie*, Van Dongen, "Mistaken Identity", Van Besouw & Van Dongen, "Reception of relativity".
[474] Wazeck, *Einsteins Gegner*, pp. 33-36.

became professional and specialized researchers.[475] Where scientific societies had only played a marginal role in the first half of the nineteenth century, their importance now very much expanded in the period 1850-1900. However, important to notice is the fact that specialized scientists played a very prominent role in these renewed societies.[476]

I believe that the origins of the unchallengeable status of Dutch science can be found in this period. Because of their role in scientific societies, Dutch scientists enforced both prominent and prestigious position in the eyes of their public, and especially those non-academic closely involved with science. This process was of course greatly reinforced by the remarkable success of Dutch science in last decades of the nineteenth century. As already discussed in chapter two, from 1876 on, state funding for science grew rapidly. Now, as has been remarked by Wijnand Mijnhardt, this dependency on and relation with the state by 1900 had loosened the ties between science and their public already to a great extend. In contrast to the German case, in the first decades of the twentieth century, there was hardly a non-academic tradition left in the Netherlands. Contrary to Bensaude-Vincent's claim that the gap between science and the public arose after the development of modern physics,[477] we see here that in the Netherlands, this gap was already significant *before* the arrival of that physics, and must largely be ascribed to institutional changes. Importantly, this gap was generally accepted in Dutch public opinion, probably due to the success of science in the period of its creation. Thus, in Dutch culture, the position of scientists was much more extraordinary than it was in Germany; because of that *and* the Dutch self-image of being a reasonable and objective people, I think it is safe to assume that severely criticizing science was *not done*. Inveighing against relativity was probably even worse than usual because its connection with Dutch science and the public and visible role Einstein played in establishing admired internationalist and pacifist ideals.

[475] See e.g Mijnhardt, "De Akademie", Theunissen, *Nut*, Van Berkel, "Oude en nieuwe universiteit", Maas, "Civil Scientists".
[476] Van Berkel, "Oude en nieuwe universiteit", pp. 178-180, Mijnhardt, "De Akademie".
[477] Bensaude-Vincent, "A genealogy".

7. Conclusion

Even though Dutch reactions to relativity differed significantly from those in France, Germany and Britain, a striking similarity is the fact that in all these countries, the reception was largely shaped by the First World War and its consequences. However, in France and England this meant that anti-German sentiments impeded the dissemination of relativity theory. In Germany itself, both Einstein's politics and relativity theory were considered by conservatives and reactionaries unwanted expression of modernism. In the Netherlands, the reception of relativity was in fact positively coloured by the consequences of the Great War. The Dutch inclination towards neutrality and international reconciliation resonated with their perception of Einstein, especially his image as a victim of radical groups. When Einstein's own views on internationalism and pacifism became known, these further boosted his public image. The Dutch public could identify itself with Einstein as a person, a process which of course also aided the swift and positive reception of relativity theory. In an age of renewed nationalism, the Netherlands were looking for international prominence, and Einstein fitted well with their 'national identity' based on peace, law, and neutrality.

Decisive in the reception of relativity were the close connections between Einstein and his Dutch colleagues. As Dutch scientists themselves were held in high prestige in the Netherlands, the connections between Einstein, Lorentz and Ehrenfest enormously increased the visibility of Einstein and his theory of relativity. As we have seen, physicists as Lorentz and Kamerlingh Onnes were eminent figures in Dutch culture. They embodied the picture of the selfless and objective scientist, and their lectures were widely reported in the newspapers. Cultural journals dedicated ample space to the natural sciences. Because of that, and because of the fact that from 1913 on, Lorentz, Ehrenfest and Fokker would often choose relativity to present their field with, Einstein and relativity had already become familiar to the Dutch public *before* they rose to world fame after the confirmation of gravitational light-bending. In the period 1913-1919, the Leiden physicists already had convinced the intellectual sphere of the merits and charm of relativity theory.

Due to this picture of a famous yet impartial scientist under attack of unwanted elements in neighbouring countries, sympathy was created in the Netherlands for the figure of Albert Einstein. Especially after he had been appointed in Leiden, the Dutch considered their own country Einstein's save haven from anti-Semitism, and a place where Einstein's internationalism could be effectuated to the full. Also, relativity theory was closely linked to Dutch scientific culture. The Dutch public was certainly aware of Lorentz' contributions to relativity. Credit for special relativity was attributed to Lorentz often and in great amount, particularly in the period before 1919. Van Eeden for instance asserted in 1916 that most of the credit of relativity had to go to the Dutch Nobel Prize laureate, but even in 1923, Van der Waals jr. would still argue that special relativity had been only a very slight modification of Lorentz' earlier and more important electron theory. Einstein was thus considered an asset – we have seen him being referred to as 'the Leiden professor' – as he enhanced the international status of the Netherlands. Furthermore, his work also contributed to a renewed appreciation for native physicists. Science was certainly used to enhance international prominence; therefore relativity contributed to national ambitions in multiple ways. The positive response to Einstein thus seems a logical consequence of the combination of the presence of Lorentz and internationalist ideals on the one hand, specific aspects of the Dutch reception, and the consequences of the Great War on political and social culture, aspects of the reception of relativity in an international perspective

The popularization of relativity by Dutch scientists is also a very interesting phenomenon in itself. From around 1910, physicists acquired positions on the editorial boards of several

important journals, including the leading *De Gids*. Because of that, they could control the dissemination of their work to a large extent. Discussions on worldviews, the role of scientific research, and the impact of new theories were dominated by experts. In that role, they could easily deny their opponents the opportunity to partake in serious debate. Scientists held a special position in the newspaper coverage too: their points of view were reported on frequently and with respect. The public was actually informed on criticism of relativity, as newspapers reported on articles that appeared in important journals. These notices however were in general very brief. It seems that those notices and the uncertainty they spread about relativity only enhanced public interest in the theory. The general public was not very much interested in the correct interpretation of relativity; it however was interested in scientific achievement, and scientists as public figures. The fact that relativity was seen as something mysterious and revolutionary increased public interest and thus visibility, and relativity soon became a shared metaphor for anything unintelligible or modern. This however did not in the least diminish public interest in relativity. Instead, a decline in interest seems only to have occurred when the public became convinced that relativity in fact did not have much impact on philosophy.

We can conclude from the reception of relativity that, in Dutch public opinion, science was seen as something interesting and positive. Interesting is that newspaper coverage focused on Einstein instead of relativity theory, a clear example of 'modernization' of Dutch media in the interwar period. The differences in coverage on Einstein and relativity before and after the confirmation of his theory also show that science itself was a matter that concerned the elite. However, Einstein's doings were not. Where expert lectures were only extensively reported on in titles such as the *Handelsblad* and the *NRC*, Einstein's international trips and his troubles with anti-Semites were reported on in many and diverse newspapers. Instead of being valued for his science, Einstein was considered to be an icon, a hero. This, however, would not mean that Einstein was only judged on his internationalism: his prestige as one of the world's leading physicist was, of course, vital for his popularity.

This adoration of scientists was very much related to the international prestige of Dutch science, but also to recent scientific and technological developments. As discussed, the Netherlands was very prosperous in the 1920s compared to neighbouring countries. Cultural pessimism only became significant in Holland after the economic crisis of 1929. In the 1920s, the Dutch public still expected much from scientific development, even though science was often seen as unintelligible and scientific knowledge as reserved for a small elite. Even this was however changing rapidly. Due to the democratization of society and increased accessibility of the universities after the 1917 "wet-Limburg", audiences for science kept growing. An increased demand for scientific knowledge, also from industry and agriculture, thus coincided with the immensity of the public reactions to relativity. These processes are of course related; we can safely assume that they enforced each other. The fact that such famous scholars as Heymans and Bolland and writers as Couperus, Van Deyssel, and Van Eeden responded to relativity increased public interest even further.

The fact that scientists put as much effort in popularization as they did in the interwar period is certainly related to the developments discussed. In general, it seems evident that science and scientists played an important role in Dutch society in the period under consideration. For the public at large, science was entertainment, but also an instrument to increase national self-esteem. In the intellectual sphere, possession of scientific knowledge seems to have been a sign of sophistication. Although this partly explains the scale of popular science, popularization was not only a response to a growing demand; it was also a way to enhance both the visibility and the authority of institutional science. As we have seen, scientists like Van der Waals and Fokker felt urged to publish popular work. They perceived the legitimacy of especially non-applied science to be under pressure. Fokker clearly argued that

popularization was a lifeline for theoretical physics. By popularizing relativity, Fokker felt that he could legitimize his own work in the eyes of the public.

However, this pressure does not seem to have played a direct role in the popular reception of relativity. I have found negative reactions based on the fact that relativity was not useful neither in the newspapers nor in extended publications on relativity. Although we have seen a reporter of *De Groene* who seemed more impressed by medical science than by relativity, there was no *demand* for science to be applicable. Applied science might have been valued more by some groups, but theoretical physics was appreciated for other aspects. The theory of relativity fitted in well with philosophical debates on causality and determinism. Due to these debates and the prestige of figures such as Lorentz and Einstein, it seems that the legitimacy of physics was not in the least compromised. As discussed, this fits in with what others have written about the popularization of science in the early twentieth century: not only the utility of a scientific development, but also its connections to other knowledge and debates present in public discourse are very important to the amount of public interest raised.[478] Although there certainly was a call from industry, politics and especially from within science itself to focus on applications and practical use,[479] this call was not reflected in public opinion.

In contrast, around 1922, when Fokker voiced his concerns, it seems that the public appreciation of physics was especially high. Both in public opinion in general as well as in the intellectual sphere, *la science pour la science* was still regarded as a rightful and legitimate cause for studying relativity. This, however, might have been different for other disciplines. As Peter Bowler has shown in the British case, both public expectations and styles of popularization varied per field, and seem to have been connected to the 'distance' between experts and amateurs.[480] Where for theoretical physics this distance seemed enormous, as all accounts on general relativity expressed, a more down-to-earth discipline as chemistry might in fact have been appreciated especially for its actual applications rather than its influence on worldviews.

Because of both its connection with Dutch science, the popularity of foundational debates, and its supposed influence on those worldviews, the theory of relativity was of course particularly suitable to represent physics with. The overturning of 'older certainties' such as the validity of Euclidean geometry and Newtonian space-time, at least metaphorically resonated well with social changes. In a period of rapid democratization and changing international relations due to the First World War, it is predictable that philosophical and ideological debates gained momentum. As relativity undermined Kantian philosophy, it seems to have been almost inevitable that the theory became intermingled in such debates. In that sense, it is hardly surprising that relativity became associated with such notions as relativism and Dadaism. And whereas relativity thus seemed to make claims on the certainty of knowledge, its cultural influence suddenly seemed far more concrete than scientists suggested.

To be sure, Dutch physicists did not approve of these associations between relativity and social changes. Of course, there were a few exceptions such as Kohnstamm and Mannoury, but these were not main experts on relativity. The likes of Fokker, Ehrenfest, Lorentz, Van der Waals, and De Sitter would counter associations between relativity and social changes by arguing that relativity's supposed influence on worldviews was in fact severely exaggerated. Fokker's holistic worldview *was* based on relativity, but this was explicitly a *physical* worldview. Besides the fact that Fokker worked hard to avoid strong determinism, I do not feel that his particular interpretation of relativity was directly related to his political views. In particular, Fokker did not use his popular lectures on relativity to expound on his political views. Although De Jong and

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[478] Schirrmacher & Thoms, "Neue Wissensofferten", in particular p. 102.
[479] See e.g. Theunissen, "Zuivere wetenschap", Baneke, *Synthetisch Denken*.
[480] Bowler, *Science for All*, in particular pp. 243-244.

Van Lunteren have argued that there are clear links between Fokker and Kohnstamm and their ideas on relativity, De Jong and Van Lunteren also show that Fokker's thoughts are not related to politics as easily as those of Kohnstamm.[481]

Through their popular work, Dutch physicists were able to control the dissemination of relativity to a certain extent. Especially before 1919, when relativity had not yet aroused much interest, there were hardly any public reactions to the theory. Most expert popular lectures were simple expositions of the theory of relativity; this certainly contributed to slowing down the idea that relativity was arcane and unintelligible, as was in fact declared by most physicists early on in for instance France and Britain. After 1920, the experts still remained the main source for information on relativity in the newspapers, as discussed. In cultural journals and magazines on popular science, debates on relativity however could not be tempered. Physicists did try to steer these debates, and thereby became engaged in debates on the boundaries of science and philosophy, and epistemological debates in general.

These debates were clearly influenced by institutional changes in society. Questions on the position and role of science certainly carried momentum, which most likely intensified these debates. Besides that, the amount of expert popularization was at a high in the interwar period. In order to determine the effects of these factors, it is interesting to compare these debates on popular science with debates in other periods. What we have seen here is that especially compared to more general studies on nineteenth century science popularization, the exclusion of non-experts played an important role in the Dutch reception of relativity. But, in contrast to other accounts where demarcations between experts and others were in general designed to either exclude or constrain amateurs, we have seen that in the Netherlands, the demarcation between specialists and non-experts was used to negotiate the limits between science and philosophy, and the influence of science on religious thinking and worldviews in general. I have argued that this particularity in the Dutch relations between science and the public stemmed from institutional developments in Dutch scientific culture. When scientific societies and popularizations of science became popular in the second half of the nineteenth century, that is, when structures for 'popular science' were created, scientists were already specializing, and a gap between professionals and their public arose naturally. Because of that, there hardly was any 'science' outside the universities, and 'top-down communication' between science and the public was generally accepted. Groups on the fringes of science that did consider themselves competent to engage with modern science certainly did not attain significant support in the Netherlands.

As the *Welträtsellöser* described by Wazeck, the group which engendered most opponents of relativity theory in Germany, in fact was such a group on the fringes, the cultural role of 'popular science' in the Netherlands is another reason for the relatively positive reaction to relativity in the Netherlands. As the *Welträtsellöser* were not only significant in number, but also held a distinct anti-academic attitude, the situation in Germany strongly contrasts with that in the Netherlands. I will come back to this in a moment. First, I would like to draw attention again to a few conclusions from my analysis of intellectual debates on relativity. First of all, we have seen that, in contrast to other countries, clear opposition to and rejections of relativity were almost non-existent. In general, the Dutch reception of relativity was more nuanced. Most authors that engaged in debates on the interpretation of relativity were keen to praise Einstein's achievement. Especially the extension of the principle of relativity to accelerated frames of motion and the incorporation of gravitation into a wider theory were seen as great accomplishments. The interpretation of relativity, in particular the relativity of simultaneity, was

[481] De Jong & Van Lunteren, "Fokkers Greep", in particular p. 13.

on the other hand met with reservation. Noticeably, this reservation was shared by many experts. These included for instance Lorentz, who, needless to say, was considered the main authority on relativity in the Netherlands, but also Kuenen, who authored one of the first and definitely one of the most influential popular publications on relativity, Van der Waals jr., as editor of *Onze Eeuw* and *De Gids* and author of several popular works on relativity, of course also one of the most influential persons in its popular reception, and Stein, as we have seen very influential among the Catholic part of the public.

Considering the fact that, in the Netherlands, many leading experts reacted reservedly to the 'relativist' interpretation of Einstein's theory, it should not surprise us that many popular writers held similar thoughts: this again only indicates the prestige and authority scientists wielded in the Netherlands. As the main rival of the 'relativist' interpretation was very much related to Lorentz' work, one might even wonder whether this argument could be extended: is the reluctance to accept relativity connected with 'national prestige'? Anyway, as most non-experts would have attained their knowledge of relativity via the theoretical physicists, it seems only natural that a large part of the Dutch audience would be hesitant to accept the relativity of simultaneity, just as it seems natural from the above that they in fact cheered relativity and the progress it brought according to the experts.

The attitude of Dutch experts and the contrasts between the Dutch and German popular scientific cultures also calls for a depart from the usual notion of 'marginalization' in the explanation of the Dutch public reaction. As I have shown, this notion does not apply to Dutch critics of relativity theory. Instead, as is suggested by both invoking the socio-cultural context from which these critics originated and a comparison between experts and non-experts, I have proposed a more positive and symmetrical explanation of their reactions to the theory of relativity. Rather than only as a reactionary attitude to modern science, epistemological and philosophical critiques on relativity can also be considered to have tried to change the course of modern science in a more positive way; there certainly seemed to be support for such attempts from within professional science itself. Besides that, the motives of several critical authors can definitely also be understood as attempts to improve on their own scientific and social status; this especially holds for those authors that held marginal scientific positions. The omnipresence of relativity guaranteed attention for its critics, and support for alternatives to the 'relativist' interpretation were, as discussed, present too.

This explanation also contrasts with Klomp's assertion that criticism of relativity must be understood as a conservative reactions determined by effects of the pillarization. As I have shown, common grounds between critics from distinct pillars were certainly more essential than the differences between them. Nevertheless, as both Klomp and Van Dongen have remarked, criticism to relativity must be studied in the light of socio-cultural modernization;[482] the reception of relativity is of course very much influenced by social changes. Conservative reactions were often disguised attacks on 'modern' elements. What they most protested was the displacement of their religious and philosophical epistemologies. However, it has also been argued that those reactions were meant as a defence against the emergence of experts and specialization in science. I have shown that, although this might be true in some cases in the Netherlands, it certainly is not true in general.

[482] Klomp, *De Relativiteitstheorie*, Van Dongen, "Mistaken Identity".

Appendix: Note on sources

In order to write a bottom-up study on the public discussion of a certain phenomenon, primary sources must be studied systematically. In my case, the reception of relativity in the Netherlands, a great advantage is the fact that much primary material has already been explored and documented in Henk Klomp's 1997 PhD thesis *De Relativiteitstheorie in Nederland*, to which I am very much indebted for finding many of the resources. Another invaluable work is Maurice Lecat's *Bibliographie de la Relativité*, published in 1924. Lecat's book consists of a list of thousands of publications on relativity, including many in Dutch. Further examination of library collections and lists of publications of several important figures have only produced a few new Dutch reactions to relativity theory, although I have found several journals that have not been included in either Klomp's account or Lecat's bibliography.

Many of the most important Dutch journals of the interwar period have been digitalized in one of two databases. The first, the *Digitale Bibliotheek voor de Nederlandse Letteren* (Digital Library of Dutch Literature) is accessible via http://www.dbnl.org/ (accessed on July 25, 2013) and includes in the period under consideration full, searchable texts of such titles as *De Gids* and *Onze Eeuw*. The other, *Tijdschriften 1850-1940* of the *Koninklijke Bibliotheek* (National Library of the Netherlands) similarly includes full searchable text versions of for instance *De Ingenieur*, *De socialistische gids*, *Vragen van de Dag,* and *Studiën*, and can be found online via http://tijdschriften.kb.nl/ (accessed on July 25, 2013). Both databases have been immensely valuable for my research. Nonetheless, many other journals I have used are not (yet) digitalized. For instance *De Nieuwe Gids*, *De Natuur*, and the *Tijdschrift voor Wijsbegeerte* were only available in paper versions.

None of the previous studies on relativity in the Netherlands has made use of newspaper articles in the way in which I have used them. Here too, the main source has been the *Koninklijke Bibliotheek*, which has digitalized versions of many newspapers available at http://kranten.kb.nl/ (accessed on July 25, 2013). Although these newspapers are searchable, a significant part of the articles that in fact does contain used search terms will not be found, due to effects of the used format. Furthermore, some important newspapers are not or only partially available, most notable the *Nieuws van de Dag*, which is only available up until 1914. *De Telegraaf* has not been accessible during most of my research, but at this point (July 25) it is in fact available via the *Koninklijke Bibliotheek*. I have not been able to incorporate coverage of *De Telegraaf* in full, but have included some references in footnotes. Importantly, its reports do not deviate significantly from those of other leading newspapers. *De Telegraaf*, a popular and 'neutral' newspaper, that is, not directly affiliated with a political or religious 'pillar', did not pay much attention to relativity before 1920, and after that was mostly interested in Einstein's connection with the Netherlands and his personal life. Like other newspapers, it renounced anti-Semitic and nationalist attacks on Einstein made in Germany – *De Telegraaf* in fact had been 'anti-German' during the war – and considered Einstein as the epitome of the reasonable and selfless scientist.[483]

Notwithstanding the above, I have tried to attain a level of coverage as complete as possible. All in all, I believe that I have seen by far the largest part of the coverage on Einstein and relativity in the Netherlands, and particularly, I have reasons to believe that I have seen almost all of the 'influential' reactions to relativity. Articles in newspapers in which relativity and Einstein were mentioned multiple times for instance have a much higher chance of being

[483] See for instance *De Telegraaf*, September 1, 1920, p. 7, "Wetenschappen: prof Einstein". For an assessment of the newspaper's position and audience, see Wijfjes, *Journalistiek*.

found by the database of the *Koninklijke Bibliotheek*. Furthermore, in the period under consideration, Dutch newspapers regularly discussed the content of recent issues of important journals and magazines. Especially articles that were noteworthy or controversial were often reported on. Of course, articles in these journals frequently referred to each other too. Having studied several thousands of newspaper articles and several of hundreds other publications – articles in journals, booklets, and other popular writings – on relativity theory, I would be surprised to find any influential articles I am as yet unaware of.

To end with a note on my bibliography: I have chosen to refer to newspaper articles in general only in footnotes, the exceptions being a few articles focusing fully on relativity theory in which the author is also clearly recognizable – these are articles by Lorentz, Schouten and Polak. Likewise, some articles published in cultural journals have not been included in the biography. This of course concerns articles which are not central to my thesis; for instance articles that referred to Einstein or relativity metaphorically. These articles too have been fully specified in footnotes. The same holds for reviews: only extended reviews with a clearly recognizable author are included in the bibliography. This, I believe, has resulted in the advantageous situation where only the most important publications on relativity have been included in the bibliography: other works can be found in footnotes.

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