Natura Artis Magistra's popular mineralogy

Ideas of nature in the popularisation of mineralogy between 1838 and 1938 with *Natura Artis Magistra* as the socio-scientific hub

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Abstract

This research creates a synoptic overview of mineralogy accessible to non-expert audiences in articles, books and 'on-site' activities such as lectures and exhibitions with *Natura Artis Magistra* as the socio-scientific hub between 1838 and 1938. The popularization of mineralogy remains understudied as it is overshadowed by other popular nineteenth- and early twentieth century subjects such as the evolution of the earth in geology or the new practical natural history that focussed on organisms' behaviours and interactions with their environment. Studying mineralogy as a non-evolutionary discipline about non-living nature has provided new insights into the understanding of nature in the period concerned. I adopt Elizabeth Ferry's use of 'regimes of nature' to examine the conceptions of nature presented in these popular products. The 'nature as order'- and 'nature as leisure'-regimes are bound to certain periods and authors and can also be recognized in products on living nature. Yet, the 'nature as resource'-regime appears to be uniquely universal in popular mineralogy.

Foreword & acknowledgements

In February 2020, I successfully finished my internship at Teylers Museum. Here, I shared an office with Jan Stobbe who was working on the mineralogical collections of the museum. I think I speak for many if I say that rocks are not very intriguing objects at first sight. Jan, however, showed me the beauty of the objects and above all, the omnipresence of minerals in our buildings, cell phones etc. It made me wonder how the first visitors of Teylers Museum and other natural history museums have looked at these objects. I would like to thank Jan for sparking my interest in this wonderful subject.

This thesis was written under the unusual circumstances of the COVID-19 pandemic. From the start, I had constructed my research plan in such a way that I could switch to online sources whenever museums and archives would close. I spent my first months looking at the digitized magazines and books and went to the archives when possible. I would like to thank Dr. Daan Wegener for suggesting to look at this popular literature on mineralogy in addition to museal practices concerning mineralogy. Lastly, I would like to express my gratitude to Dr. Hieke Huistra, for helping me construct this hybrid research plan and all her feedback and suggestions in the execution. I have enjoyed our videocalls and I hope we will meet in person soon.

INTRODUCTION

'The plant may please us with its beauty, the animal may allure us in its phenomena of life, among the minerals the acting, the thinking man himself comes on the scene. The history of the mineral exists to a certain extent only through the presence of man who works and treats it, and who thereby always shows himself in favourable light.'[1] (dr. T.C. Winkler, 1870)

In the opening of his popular book *Treasures of the Earth,* dr. Tiberius Cornelius Winkler points out that the history of minerals is bound to human history, to a certain extent. Humans have always mined earth's resources to create a wide variety of utility objects. This remains true up to present day. Minerals are, therefore, pre-eminently interesting objects of study in recent debates on the nature-culture dichotomy and ideas of nature therein.[2] Moreover, Winkler's book itself provides an ideal source to study ideas of nature, assuming popular works like his were meant to teach a broad audience how they relate to nature and how to interact with nature.

Historians of science and culture have already written extensively on the popularisation of nature in the nineteenth century and the beginning of the twentieth century in the Netherlands.[3] However, these studies have mostly focussed on the popularisation of living nature. The few studies that have focussed on the popularisation of non-living nature, often only addressed the historical or evolutionary study of non-living nature: geology.[4] The popularisation of the non-historical study of non-living nature, mineralogy, remains little researched. This thesis therefore studies the popularising activities concerning mineralogy of the Amsterdam society 'for promoting the knowledge on natural history' *Natura Artis Magistra* between 1838 and 1938. Studying popular mineralogy has provided

[1] T. C. Winkler, *De schatten van de aardbodem* (Kruseman, 1870) 1. 'De plant moge ons bevallen door hare schoonheid, het dier moge ons aanlokken in zijne levensverschijnselen, bij de delfstoffen treedt de handelende, de denkende mensch zelf op het toneel. De geschiedenis van de delfstof bestaat in zekere mate slechts door de aanwezigheid van den mensch die haar bewerkt en behandelt, en die zich daarbij steeds in gunstig daglicht vertoont.'

[2] See e.g. Elizabeth Ferry, Annabel Vallard, and Andrew Walsh, *The Anthropology of Precious Minerals* (Toronto, University of Toronto Press, 2019) ; Nicole Boivin, 'From Veneration to Exploration', in *Soils, Stones and Symbols Cultural Perceptions of the Mineral World. Archaeological and Anthropological Perspectives on the Mineral World.* (Taylor and Francis Group, 2004) ; Susannah Gibson, *Animal, Vegetable, Mineral?: How Eighteenth-Century Science Disrupted the Natural Order* (Oxford: Oxford University Press, Incorporated, 2015).

[3] See e.g. Liesbeth Coffeng, 'Het album der natuur. Popularisering van de natuurwetenschap in een tijdschrift uit de eerste helft van de negentiende eeuw', *Groniek* 123 (1994): 53–66 ; L. Dresen, *Op Weg Naar Nationale Natuur: Natuurjournalistiek in Nederland, 1850-1910* (Nijmegen Loket Dresen, 2020); Bert Theunissen, 'Natuursport en Levensgeluk: Hugo de Vries, Eli Heimans en Jac. P. Thijsse', Gewina 16 (1993): 287–208.

[4] E.g. Liesbeth Coffeng, 'Het album der natuur. Popularisering van de natuurwetenschap in een tijdschrift uit de eerste helft van de negentiende eeuw', Barbara Allart, ''De Wetenschap Heeft "t Uitgemaakt" Wetenschapsbeelden in Nederlandse Publiekstijdschriften, 1840-1900' (Utrecht, University Utrecht, 2003) ; Kristine M Larsen, *The Women Who Popularized Geology in the 19th Century* (Springer International Publishing AG, 2017) & Adelene Buckland, *Novel Science: Fiction and the Invention of Nineteenth-Century Geology* (Chicago: Univ. of Chicago Pr, 2013).

new insights into the ideas of nature in the period concerned.

Natura Artis Magistra (*Artis)* was founded in 1838 by three Amsterdam-based entrepreneurs. Nowadays, ARTIS is best known for its collection of living animals, but since its foundation in 1838 the society also possessed a substantial library, ethnological objects and a traditional natural cabinet.[5] *Artis* also possessed a collection of minerals.[6] Around 1900, the zoo housed ten different museum buildings in which these objects were stored and displayed. The members of the society published - books and articles for a broad audience and gave lectures on everything that could be found on the zoo's grounds.[7] In 1938, due to financial reasons, the society had to give its objects to other institutes in Amsterdam including the municipal university.

Since I will act as a pioneer in the study of mineralogy popularisation, I will look at a wide range of popularising undertakings. I aim to produce a local case study of mineralogy in popular culture, similar to how Tatjana Buklijas has conducted her study in 'Public Anatomies in Fin-de-Siècle Vienna'. [8] The goal is to create 'a synoptic perspective' of various kinds of mineralogy accessible to non-expert audiences of *Artis*. To be more specific, I will be looking at a range of popular books on mineralogy and articles on mineralogy in the popular journals *Album der Natuur* and *De Levende Natuur* between 1838 and 1938. These works were either present in the library of *Artis* or written by members of the society.[9] In addition to written popular culture, I will also be looking at what I term 'on-site' activities organised in or by (members of) *Natura Artis Magistra.* This includes the society's presentation of its own mineralogical collection and lectures held on site, but also temporary exhibitions held in Amsterdam in which loans of *Artis'* collection are presented or members of *Artis* were involved in the organisation.

To examine the ideas of nature presented in popular mineralogy, I draw on Elizabeth Emma Ferry's use of 'regimes of nature'.[10] The regimes of nature were first conceptualised by Arthuro Escobar as a '… framework for investigating the manifold forms that the natural takes in today's

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[5] Donna C. Mehos, 'Natuurhistorische Verzamelingen En Het Amsterdamse Culturele Leven in Artis 1838-1881', in *Het Verdwenen Museum: Natuurhistorische Verzamelingen, 1750-1850*, ed. Bert Sliggers and M. H. Besselink (Blaricum/Haarlem: V+K Pub./Teylers Museum, 2002), 187

[6] See e.g. 'Kon. Zoö. Bot. Genootschap', *Het Vaderland : staat- en letterkundig nieuwsblad*, 13 September 1880, https://www.delpher.nl/nl/kranten/view?coll=ddd&identifier=MMKB23:001405063:mpeg21:a00021.

[7] Donna C Mehos, *Science and Culture for Members Only: The Amsterdam Zoo Artis in the Nineteenth Century*, 2006, https://doi.org/10.1515/9789048503810, 91-112.

[8] Tatjana Buklijas, 'Public Anatomies in Fin-de-Siècle Vienna', *Medicine Studies* 2 (2010) 71-92.

[9] See e.g. Library University of Amsterdam (Artis Bibliotheek), 'Handboek Voor Den Verzamelaar : Een Praktisch Boek, Leerende Het Aanleggen, in Orde Maken En Onderhouden van Alle Soorten van Verzamelingen, Voor Jongelui Bewerkt', accessed 20 June 2020, https://lib.uva.nl/discovery/fulldisplay?docid=alma990030847260205131&context=L&vid=31UKB_UAM1_INST:UVA&lang=en&search_scope=DN_and_CI_and_PURE&adaptor=Local%20Search%20Engine&tab=Everything&query=any,contains,handboek%20voor%20den%20verzamelaar&offset=0.

[10] Elizabeth Emma Ferry, '"Ziegfeld Girls Coming Down A Runway": Exhibiting Minerals at the Smithsonian', *Journal of Material Culture* 15, no. 1 (March 2010): 30–63, https://doi.org/10.1177/1359183510355224.

world.'[11] Escobar recognised three regimes of nature, namely 'organic nature', 'capitalist nature' and 'technonature'. In her research on the exhibiting of the mineralogical collections of the Smithsonian Institute, Ferry breaks down the category of 'capitalist nature' to four more subtle regimes and explains how these coexisted and shifted over time.[12] Like Ferry, I find the regimes of nature a useful concept to investigate the forms that the natural took in popular mineralogy in the nineteenth and early twentieth century.

Before I discuss my findings, however, I will first discuss what the study of mineralogy encompassed between 1838 and 1938 and why it is interesting to study in the popular context of *Artis*. Simply put, mineralogy is the study of minerals and has had two main goals from the eighteenth century up to present day. [13] The first goal of mineralogy is the classification of minerals and the second is understanding the formation of minerals in the earth's crust. What was understood to be a mineral and how these objects were studied, however, has changed throughout history. Historically, mineralogy is closely related to natural history and chemistry until it became a subdiscipline of geology in the universities in the nineteenth century. This reshaping of disciplinary boundaries took place during the first formative years of *Artis*. The definitions and boundaries of mineralogy were therefore often blurred in the sources studied. The introduction serves to justify my choices in primary source material; what can be seen as popular mineralogy and what not?

The first part of this introduction will address how in the nineteenth century natural history increasingly came to mean the study of living nature.[14] A new way of doing natural history developed which had a big appeal to the general public and is often seen as the precursor of ecology. This development mainly took place outside of the universities within the contexts of the first zoos such as *Artis.* The 'new' natural history mainly focussed on plants and animals and by doing so it excluded the study of minerals. The second part of this introduction explains how mineralogy came to be seen as a subdiscipline of geology instead. A shift in the ontological status of the earth's specimens takes place in this process, wherein minerals and rocks came to be seen as sources of the earth's past.[15] Thirdly, I will discuss mineralogy's close relation to chemistry. Since the sixteenth century, mineralogists have used chemical methods to determine minerals' characteristics such as its composition and crystal

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[11] Arturo Escobar, 'After Nature: Steps to an Antiessentialist Political Ecology', *Current Anthropology* 40, no. 1 (February 1999): 1–30, https://doi.org/10.1086/515799, 1.
[12] Ferry, '"Ziegfeld Girls Coming Down A Runway"', 32.
[13]Rachel Laudan, 'Mineralogy and Petrology', in *The Oxford Companion to the History of Modern Science*, ed. J. L Heilbron and James R Bartholomew (Oxford; New York: Oxford University Press, 2003).
[14] Lynn K Nyhart, 'Publics and Practices', in *Worlds of Natural History*, ed. Helen Anne Curry et al. (Cambridge: Cambridge University Press, 2018), 335–47, https://doi.org/10.1017/9781108225229 336-337 ; Lynn K Nyhart, 'Natural History and the "new" Biology', in *Cultures of Natural History*, ed. Nicholas Jardine, James A. Secord, and E. C. Spary (Cambridge ; New York: Cambridge University Press, 1996), 426–43.
[15] Noah Heringman, *Romantic Science: The Literary Forms of Natural History* (Albany, United States: State University of New York Press, 2003), 63.

structure. Lastly, I will argue why and how *Artis* forms an interesting case study for the ideas of nature present in popular mineralogy.

A 'new' natural history

From the sixteenth century until the early nineteenth century, minerals were seen as the third kingdom of nature studied in natural history besides the animal- and plant kingdom. All inorganic materials that could be mined from the earth were seen as minerals, including soft rocks and fossil remains. The main goal of natural history during this period was the stocktaking and categorisation of nature. Rachel Laudan shows that during the eighteenth century, mineralogists would publish new taxonomic systems almost annually.[16] Mineralogists would study their minerals for a huge variety of characteristics from colour and shape to hardness, cleavage, electric conductivity, chemical composition and more. Whereas botanists eventually chose to stick with Linnaeus' system based on plants' reproductive organs as the most important classificatory characteristic, mineralogists kept arguing over the different rankings the characteristics should have to best systematize their material. Classifying minerals still remains one of the most important goals of mineralogists today.

From early nineteenth century onwards, mineralogists mostly focussed on primary or, in other words, hard rocks.[17] Soft rocks and fossils were taken up by other disciplines such as geology and palaeontology. In the second half of the century, the discipline of mineralogy was even further limited to the study of homogenous rocks consisting of just one mineral. Rocks consisting of distinct assemblages of minerals officially fell under the new subdiscipline of mineralogy: petrology. The Netherlands consists for 99% of unconsolidated Quaternary deposits and provides little material for mineralogists to study.[18] The Dutch, consequentially, have never been very active in the field. The mineralogical activities that were undertaken, were mostly done by private individuals who could afford to collect items from abroad, including the former Dutch colonies. Universities did offer classes in mineralogy. These were often given by professors of the overarching subject of natural history. In the rest of Europe, special mining schools for training engineers arose everywhere, stimulated by the industrial revolution. The classification practices in mineralogy were essential for practical applications in the mining industry. In the Netherlands, the Polytechnische School in Delft was the first institute with a chair for the earth sciences in 1843. This school mainly trained mining engineers.

In the second half of nineteenth century, the study of natural history witnessed a practical turn wherein mainly living organisms were studied in relation their environment, thus moving beyond

[16] Rachel Laudan, *From Mineralogy to Geology: The Foundations of a Science, 1650 - 1830*, Science and Its Conceptual Foundations (Chicago, Ill.: University of Chicago Press, 1987), 70-76.
[17] Laudan, 'Mineralogy and Petrology'.
[18] A.J. Pannenkoek, 'Geological Research at the Universities o Fthe Netherlands, 1877-1962', *Geologie En Mijnbouw* 41 (1962): 161–74.

classificatory practices.[19] Lynn Nyhart argues that 'the rise of institutions like the zoo and the public natural history museum, together with the development of organised hobbyist natural history pursuits such as birdwatching and aquarium-keeping, came to form a cultural system of public-oriented natural history, focused on living organisms'.[20] The development of this 'new' natural history has long been overlooked because it took place outside of the universities. Within the university walls, the study of living organisms increasingly focussed on animal- and plant physiology. Physiological research was done in laboratory settings with specialized equipment and therefore hard for amateurs to engage in.

According to Lynn Nyhart, the new natural history that focussed on behaviour and interactions was very influential for the general ideas of nature.[21] Especially since this natural history was very accessible to a broad audience, the concept of nature it propagated is more likely to have been caried broadly. The change was performed by people on the sidelines of the universities such as zookeepers, teachers, conservators and amateur enthusiasts. Nyhart describes the process as 'the rise of the biological perspective'. A similar development is visible at the end of the century in *Artis,* where the Amsterdam schoolteachers Jac Thijsse and Eli Heimans for example were inspired by their visits to the zoo. They wrote articles and books on natural history for a broad audience well into the twentieth century. On top of that, they founded the magazine *De Levende Natuur* which still exists. Klaas van Berkel has called this popular interest for natural history the biological 'reveil' of the late nineteenth century.[22]

Mineralogy's 'old' natural history approach with categorization as the main goal, no longer matched the approach of the new practical natural history. In 1876 the Dutch government released a new educational law that stated that faculties of mathematics and natural sciences should offer specialized courses in mineralogy. [23] The Government universities in Leiden, Utrecht and Groningen established chairs in geology to teach these courses.[24] Mineralogy had thus transformed from a subdiscipline of natural history to a subdiscipline of geology. Its main task remained classifying the different specimens that geologists studied.

The municipal university in Amsterdam also established a chair in geology in 1891 which was taken by professor Gustav Molengraaff. In a document between the municipality of Amsterdam and *Artis* it was stated that Molengraaff would get access to the mineralogical collection in the Aquarium

[19] Nyhart, 'Publics and Practices', 340.
[20] Ibidem, 336.
[21] Lynn K. Nyhart, *Modern Nature: The Rise of the Biological Perspective in Germany* (Chicago: University of Chicago Press, 2009),
[22] Klaas van Berkel, 'Heimans En Thijsse En Het Boek Der Natuur', in *Citaten Uit Het Boek Der Natuur: Opstellen over Nederlandse Wetenschapsgeschiedenis* (Amsterdam: B. Bakker, 1998), 266.
[23] G.E. de Groot, 'Rijksmuseum van Geologie En Mineralogie 1878 - 1978', *Scripta Geologica* 48 (1978): 3–25, 4
[24] Pannenkoek, 'Geological Research at the Universities of the Netherlands, 1877-1962', 163-166.

of *Artis* which was designed, in part, in 1888 to facilitate the municipal university classes.[25] Molengraaff's successors were specialised in palaeontology and physical geography, sciences that rarely study mineralogical specimens.[26] In 1924, *Artis* noticed that the mineralogical collections were barely used and asked for them to be transferred to the university.[27] In 1938, the entire natural collection was transferred to the university and other museums in the city. The mineralogical and geological collections ended up in the Geological Museum of the university that was accessible to staff and students only.[28]

All throughout the hundred years that I have studied, however, minerals were still regularly referred to as a third part of nature.[29] Mineralogists could not study their non-living objects in the way natural historians of living nature did. The appeal of living nature for their behaviour, lifecycles and interactions was often explicitly mentioned by the popularisers of mineralogy and contrasted with the appeals that the mineralogical kingdom offers. Herman Christiaan van Hall in his *Speeches on geology and mineralogy* (1840) for example states:

> 'Although the knowledge of minerals at glance does not yield that pleasantness and variety which the study of the animal- and vegetable kingdom imparts; … although we above all miss that instinct, a for us so incomprehensible natural drive, among animals the source of so many highly remarkable specialities, so does the mineral kingdom or raw realm, on the other hand, provide us much, very much that is very worthy of our attention… .'[30]

Van Hall explains here that minerals do not possess any interesting 'instincts' or 'natural drives' as a source for so many of the remarkable specialities of animals, but that minerals are still interesting. The reasons why these minerals were interesting were multiple. I will discuss these in my chapters on the regimes of nature found in my source material.

In some cases, authors even claim minerals can be seen as living or be made alive to appeal to their audience. Franz von Kobell in his *Mineralogy: popular speeches* (1868) states: 'The interest of the

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[25] 'Stukken Betreffende de Overkomst Met de Gemeente Terzake de Mineralogische, Geologische En Paleontologische Verzamelingen En Het Beheer Daarvan, 1890-1925' (Stadsarchief Amsterdam, n.d.), 775, 395 Inventaris van Het Archief van Het Koninklijk Zoölogisch Genootschap Natura Artis Magistra. ; Mehos, 'Natuurhistorische Verzamelingen En Het Amsterdamse Culturele Leven in Artis 1838-1881', 206.
[26] Pannenkoek, 'Geological Research at the Universities of the Netherlands, 1877-1962',
[27] 'Stukken Betreffende de Overkomst Met de Gemeente Terzake de Mineralogische, Geologische En Paleontologische Verzamelingen En Het Beheer Daarvan, 1890-1925' (Stadsarchief Amsterdam, n.d.), 775, 395 Inventaris van Het Archief van Het Koninklijk Zoölogisch Genootschap Natura Artis Magistra. 'Zij stichten daar geernerlei nut; zij zullen beter tot hun recht komen, als zij een plaats vinden in de verzameling van het mineralogisch-geologisch Laboratorium der Universiteit, waar zij t'huis behoren.'
[28] Fred de Ruiter, *Natuurschatten. Natuurhistorische collecties in Nederlandse musea.* (Utrecht: Stichting Matrijs, 2020).
[29] See e.g. Eli Heimans, 'Gesteenten', *De Levende Natuur* 14, no. 1 (1909): 6–9, 6.
[30] H. C. van Hall, *Redevoeringen over de geologie en delfstofkunde* (Groningen: Oomkes, 1840), 3-4.

zoologist and botanist is sustained by the vital activity of the objects he studies; but the minerals also become alive when physics and chemistry shed light on their inner being.'[31] According to Von Kobell, what makes animals and plants interesting is their 'vital activity'. Yet, this vital activity can be activated in minerals by studying them using physics and chemistry. This example from Von Kobell's work shows how popular the new natural history of living nature was at the time. The public was drawn to this vital activity.

Some of these instances in which minerals are made to seem alive, authors refer to the formation processes of the minerals. Von Kobell states: 'It can be seen that the force which crystallizes the raw material of the stones is about the same as the life force of animals and plants.' [32] P. van der Lijn speaks about there 'being no rest in those apparently dead rocks: deep in the mountains and on the surface, conversions still take place continuously… .'[33] Although these formation and conversion processes are also part of the study of mineralogy, they border on the edge of being geology. Geologists also study non-living material, but their approach differs from that of mineralogists. I will further explain the differences between mineralogy and geology in the next section.

Non-historical geology

Geology, like mineralogy, studies the outer layers of earth. Rachel Laudan argues that the theories mineralogists had about the formation of minerals before the nineteenth century, formed the basis for the theories later presented by geologists.[34] The main difference between the two sciences is that geology uses a historical mode of explanation, typical for the nineteenth century. Mineralogy could be seen as an older, non-historical form of geology. Geologists study rocks to reconstruct the history of the earth whereas mineralogists merely study rocks in and of themselves. In reconstructing the history of the earth, geologists did need mineralogical knowledge to identify minerals and rocks first. In the end mineralogy thus became a subdiscipline of geology.

In his *Romantic Science: The Literary Forms of Natural History,* Noah Heringman presents a theory of the history of geology and our changing conception of non-living nature therein.[35] Heringman shows that during big excavations for industrial purposes such as coal digging or creating train tracks, more and more fossils and sedimental layers turned up. These specimens and strata were soon interpreted as sources for studying the history of the earth and its inhabitants. Romantic narratives of the earth arose in which rocks came to be seen as the 'archive' of natural history. The

[31] Franz von Kobell, *De mineralogie: populaire voordragten* (Breda: Broese & Comp., 1868), 39.
[32] Von Kobell, *De mineralogie,* 77 'Men ziet wel, dat het met de kracht, die de grondstof der steenen kristallieseert, ongeveer op dezelfde wijze is gestelde, als de levenskracht van dieren en planten.'
[33] P. van der Lijn, *Het Keienboek : Inleiding Bij de Studie Onzer Zwerfsteenen* (Zutphen : Thieme, 1923), 6 'Evenwel is er in dat schijnbaar doode gesteente geen rust: diepe in de bergen én aan de oppervlakte hebben nog aanhoudend omzettingen van mineralen plaats… .'
[34] Laudan, *From Mineralogy to Geology*, 20
[35] Noah Heringman, *Romantic Science: The Literary Forms of Natural History*.

18th-century geologist James Hutton, for example, claimed that rocks were legible texts registering the motive forces of the earth. His early-nineteenth century colleague, William Smith, argued that rocks were sources in which biological order inscribes itself. Quite literally, an archival 'Rock Record' of past-time worlds was created wherein the inorganic is illuminated by organic inscription.

I wish to extent Heringman's theory. I claim that the interpreting of rocks as an archive in the new discipline of geology, rocks underwent an ontological change. Since the 16th-century, rocks and minerals were considered the third kingdom of nature alongside the plant – and animal kingdom. In the 'old' natural history style of research, objects were mainly studied for a variety of characteristics and in relation to each other. Based on these observations and comparisons, taxonomic systems were designed. Rocks and minerals were researched for their colour, shape, chemical and physical properties for example. In other words, in old classificatory mineralogy, rocks and minerals were appreciated in and of themselves. In geology, rocks had been degraded to mere carriers of other more interesting information about the evolution of earth. Mott Greene stresses in *The Cambridge History of Science* that geology produced a new evolutionary worldview of earth and life. It formed 'the evidentiary foundation for a new master narrative of human life, human nature, and human history.'[36]

This new worldview made geology a popular subject among the general public.[37] In an article on collecting rocks for amateurs from 1934 in the abovementioned *De Levende Natuur*, this change in ontological status of rocks between the 'old' mineralogy and new historical geology is clearly visible. The author of the article, Mr. Van der Kley, asks: 'So what should we collect?' and answers that question with 'Stones, that speak to us, that have their history to tell. What do I care if I have all the types of stone neatly labelled together. Better collect match brands or cigar bands then!'[38] In his answer, Van der Kley advises to only collect rocks with a geological relevance which can teach you about their history. In doing so, he implicitly states that the history of a rock is of more valuable than the rock itself. According to Van der Kley, the act of collecting and labelling rocks without geological relevance, is just as valuable as collecting and studying any other item.

In short, the main difference between geologists and mineralogists is their approach of their specimen. Geology has a historical approach whilst mineralogy is non-historical. In geology, rocks' ontological status changed to being carriers of more interesting evolutionary histories. Rocks were seen as sources to tell the bigger story of the history of the earth. The main subject of geology is the

[36] Mott T. Greene, 'Geology', in *The Cambridge History of Science*, ed. Peter J. Bowler and John V. Pickstone, 1st ed. (Cambridge University Press, 2009), 165–84, https://doi.org/10.1017/CHOL9780521572019.011, 169.
[37] See e.g. Kristine M Larsen, *The Women Who Popularized Geology in the 19th Century*. & Adelene Buckland, *Novel Science*.
[38] K. Van der Kley, 'Hoe Moet Men Steenen Verzamelen?', *De Levende Natuur* 39, no. 4 (1934): 125–29, resp. 129. 'Wat moeten we dus verzamelen? Steenen, die tot ons spreken, die ons hun geschiedenis te vertellen hebben. Wat geef ik erom, of ik alle steensoorten netjes geëtiketteerd bij elkaar heb. Verzamel dan liever lucifersmerken of sigarenbandjes!'

entire earth, and rocks are only samples of it. In mineralogy, these fragments or samples were studied in and of themselves. Minerals themselves are the main object of study in mineralogy. I used this knowledge in selecting my source material. I have paid close attention to whether the rocks and minerals were the main object of study or whether they were presented as sources of the earth's past. In other words, I excluded popular geological sources on the basis of them treating rocks and minerals historically. Considering the fact that petrology is a subdiscipline of mineralogy and that this disciplinary boundary was only strictly drawn around 1900, I did include sources on the non-historical study of rocks described as assemblages of minerals.

Using chemistry and the technonature-regime

Mineralogy, historically, also had a close relation to chemistry. Chemistry's main goal was the determination of the composition of substances, including minerals.[39] For mineralogists, however, this chemical composition was just one of the many characteristics that they studied. Since the sixteenth century to the present, mineralogists used chemical research methods to study their specimens.[40] In the sources of popular mineralogy that I studied, the close relation between chemistry and mineralogy is also apparent. In Von Kobell's beforementioned quote on physics and chemistry bringing minerals alive, for example, it appears that chemical research methods were standard in mineralogy.

The number of articles that could be characterized as chemistry but also discuss minerals, rose in the popular magazine the *Album der Natuur* towards the end of the nineteenth century. A teacher in chemistry, dr. Doijer van Cleeff, and professor of chemistry, R.S. Tjaden Modderman, contributed most of these articles.[41] Doijer van Cleeff also wrote multiple articles on the chemical fabrication of certain minerals. In 1895, for example, he introduces a series on synthesizing diamonds.[42] The first article in this series is about the alchemist tradition of trying to fabricate different gems and metals such as gold. In the other articles, Doijer van Cleeff reports on the experiment of the French chemist Moissan who was capable of making very tiny diamonds in his lab by chemically working coal in different ways.[43]

In these articles on synthesizing natural products, we can recognized a first regime of nature coined by Arturo Escobar, namely technonature.[44] In the technonature regime, the line between

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[39] Frederic Lawrence Holmes, 'Chemistry', in *The Oxford Companion to the History of Modern Science* (Oxford University Press, 2003).
[40] Laudan, 'Mineralogy and Petrology'.
[41] See e.g. R.S. Tjaden Modderman, 'Een Nieuwe Grondstof Voor de Vervaardiging van Gloeikousjes.', *Album Der Natuur* 54, no. 1 (1905): 256 ; R.S. Tjaden Modderman, 'Platina En Verwanten', *Album Der Natuur* 52 (1903): 249–62.
[42] G. Doijer van Cleeff, 'De Alchymist van de Negentiende Eeuw', *Album Der Natuur*, 1891, 76–80 ;
[43] G. Doijer van Cleeff, 'Hoe Moissan Tot de Vorming van Diamant Geleid Werd', *Album Der Natuur* 42 (1893): 369–77 ; G. Doijer van Cleeff, 'Hoe Moissant Tot de Vorming van Diamant Geleid Werd', *Album Der Natuur* 42, no. 1 (1893): 369–77.
[44] Escobar, 'After Nature', 11

artificial and natural products gets blurred. Escobar's examples of technonature are mainly biological such as clones and transgenic foods wherein natural products are actually a product of human intervention. I argue that the artificial creation of minerals at the end of the nineteenth century is an inorganic example of technonature. In the article on the first synthesized diamonds, for example, the main ingredient was naturally mined coal made into diamonds by human intervention. An unknown author who also wrote on the artificial fabrication of gemstones, jokingly warned natural scientists that many a beautiful woman will not spare them if their jewellery loses its value because of their inventions.[45]

I chose not to include these technonature articles in my analysis of popular mineralogy, because they only discuss the chemical composition of minerals. Mineralogists always focussed on a multiplicity of characteristics. The chemical composition of a mineral was seen as just one of these many characteristics. Other articles that addressed minerals but mainly discussed the chemical makeup of them are also left out of my analysis.

Natura Artis Magistra as the socio-scientific hub

Lastly, all the sources of popular mineralogy that I have studied were written or organised by members of *Artis* or were closely related to *Artis* in other ways. In other words, I used *Artis Natura Magistra* as the socio-scientific hub for researching popular mineralogy. *Artis* forms an interesting hub because it not only had minerals on display, but the society also offered popular books on mineralogy in their library and organised lectures on this topic. On top of that, *Artis* drew an increasingly broad audience between 1838 and 1938. This last section provides background information about *Artis'* audiences and which forms of popular mineralogy were brought to them.

Artis was founded in 1838 with money of paying members and generous financial and material gifts.[46] The composition of non-expert audiences of *Artis* have differed throughout time. After its foundation in 1838, only members that paid 10 guilders a month for their membership could enter the zoo. This mostly attracted a high-middle class audience of men working in commerce and finance. New members had to be introduced by existing members. Non-members' guests could only enter on invitation on Thursday mornings for one guilder. In 1852, Artis introduced the 'Goedkope Maand' (Inexpensive Month). During this month non-members could visit for a reduced price that was carefully chosen to still keep the working class out. Only in the first years of the twentieth century when the zoo's membership numbers went down, did the entrance rules and entrance fees change so

[45] onbekend, 'Edelgesteenten, Door Kunst Gemaakt', *Album Der Natuur* 7 (1858): 150–54. '..., wanneer het hem gelukken mocht, ook van de edelgesteenten de wording te bespieden en de schaarschheid te verminderen, — dan, vrees ik, zal menige schoone vrouw geene genade kennen voor den natuuronderzoeker, wiens wetenschap hare sieraden van hunne waarde heeft beroofd.'
[46] Mehos, *Science and Culture for Members Only*, 21-33.

that all classes could visit. From 1852 onwards though, members of *Artis* also did increasingly organise public lectures and educational programs for Amsterdam-based teachers whom *Artis* also granted partial access to their collections. The famous popularisers of nature Jac P. Thijsse and Eli Heimans, for example, had entrance to the collections and natural knowledge via these educational programs for teachers. Overall, the zoo became increasingly accessible in the period studied.

Besides access to the zoological gardens, members and later non-member visitors also had access to the library collections.[47] I analysed two popular science magazines from this collection, namely the *Album der Natuur* and *De Levende Natuur.* From the weekly reports of the library of the period between 1890 and 1910, it appears that both these magazines were regularly requested.[48] The *Album der Natuur* was founded in 1852 by three Dutch men of science: Willem Martinus Logeman, Douwe Lubach and Pieter Harting.[49] The journal was targeted at 'every family household, where knowledge and civilization are appreciated and cultivated'. The *Album der Natuur* enjoyed around 3000 to 4000 print runs in its first years and therewith belonged to the best sold magazines of the Netherlands at the time.[50] It remained the highest recommend magazines of its genre until the end of the century. The reading audience has not yet been extensively analysed. Yet, based on the prize of 3.60 guilders per year it was suited for the lower middle class such as teachers, shop owners and craftsmen. The journal *De Levende Natuur* was set up in 1896 by Amsterdam-based teachers Jac. P. Thijsse, Eli Heimans en Jasper Jaspers jr..[51] This magazine often hosted articles on what could be found on *Artis*' sites. The magazine had a thousand subscribers in three months, which was a high number for that time. However, the number of subscribers never rose above 1700. On top of these two magazines, I have also analysed six books on popular mineralogy that were present in *Artis'* library or of which the authors held close connections to *Artis.*

Lastly, I have looked at activities that happened on the sites of *Artis* or near *Artis.* Sadly, I have not been able to find how and in which contexts *Artis* exhibited its own collection of minerals. I did find several clues as to where in the zoo the minerals were exhibited. In a newspaper article from 1880 about a robbery in the Natural History Museum of *Artis,* we learn that there was a collection of minerals present there.[52] The article states: 'cabinets with animals in formaldehyde, corals, ethnological objects, conchylia, eggs, minerals and the already more than battered collection of

[47] Ibidem, 107.
[48] 'Weekrapporten van de Bibliotheek N.B. Aangevende de Ingekomen Boeken En Tijdschriften, de Uitgeleende - En Terugontvangen Boeken En de Aantallen Bezoekers in de Leeskamer 1890-1922' (Stadsarchief Amsterdam, 1901), 1930, 395 Het Archief van het Koninklijk Zoölogisch Genootschap Natura Artis Magistra.
[49] Coffeng, 'Het album der natuur', 53–66.
[50] Dresen, Op weg naar een nationaal landschap, 656-657
[51] Theunissen, 'Natuursport en Levensgeluk', 289 ; Isa Schimmel, 'De Levende Natuur Eeuwig', *De Levende Natuur* 97, no. 2 (1996): 92–97.
[52] 'Kon. Zoö. Bot. Genootschap', *Het Vaderland : staat- en letterkundig nieuwsblad*, 13 September 1880, https://www.delpher.nl/nl/kranten/view?coll=ddd&identifier=MMKB23:001405063:mpeg21:a00021.

insects.'[53] Furthermore, in the beforementioned agreement of 1890 between the municipality and the zoo, it was agreed that the mineralogical, geological and paleontological collections of the university and *Artis* would be fused and stored in the Aquarium building in the zoo.[54] The agreement states that a part of the collection should function as a 'Showcollection' for the visitors of Artis whilst the rest was to be used for scientific purposes. In a Jubilee booklet eight years later, however, it is mentioned that the 'palaeontological-geological museum' was still being furnished by prof. Molengraaff in the west wing of the library building.[55] In 1924, *Artis* noticed that this collection was barely looked at and asked for them to be transferred to the university entirely.[56] Whether the collection had been transferred soon after, or along with the other zoological and botanical collections in 1938 remains unknown.

I have also looked more systematically into the gifts that *Artis* received.[57] *Artis* first registered having received minerals in 1853.[58] The *Yearbook* of 1853 says to have received an elaborate collection of ores and minerals from different places and 2 pieces of mercury-ore from California. The minerals were moved to the 'Museum'. This must have been the Natural History Museum since this was the only museum on the zoo's grounds at that time. From 1866 onwards, the minerals that *Artis* receives were usually moved to the 'Ethnographical Museum'.[59] In 1866, *Artis* bought a new piece of land with a building on it called De Volharding.[60] They furnished this building as an ethnographical museum to store and exhibit their ethnographical objects.

Moving newly received minerals to the Ethnographical Museum, can be interpreted as an early sign of the new natural history that excludes non-living nature. From 1866 onwards, the amount of minerals received also decreased to only one or two gifts every year.[61] In 1910, *Artis'* ethnographical museum closed its doors and in 1921 the collections were moved to the newly built Colonial Institute in Amsterdam. In short, the minerals in *Artis* between 1838 and 1938, were located in the Natural History Museum, the library's west wing and the ethnographical museum. However, the context remains too little known to pinpoint any regime of nature in the exhibition of minerals in *Artis.*

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[53] Ibidem, '…, vervolgens kasten met dieren op spiritus, koralen, ethnologische voorwerpen, conchyliën, eieren, mineralen en de reeds meer dan gehavende insecten collectie.'
[54] 'Stukken Betreffende de Overkomst'
[55] Koninklijk Zoologisch Genootschap 'Artis Natura Magistra', *Koninlijk Zoologisch Genootschap "Natura Artis Magistra" 1838 - 1 Mei - 1898*, 1898, 24.
[56] 'Stukken betreffende de overkomst'
[57] 'Registers Der Geschenken in de Diergaarde N.B. Met Kabinet En Bibliotheek, 1839-1940', 1940 1839, 1252-1314, 395 Het Archief van het Koninklijk Zoölogisch Genootschap Natura Artis Magistra, https://archief.amsterdam/inventarissen/details/395/path/265.1 ; Stichting tot instandhouding van de Diergaarde van het Koninklijk Zoölogisch Genootschap Natura Artis Magistra, *Jaarboekje van het Koninklijk Zoölogisch Genootschap 'Natura Artis Magistra'.* (Koninklijk Zoölogisch Genootschap 'Natura Artis Magistra', 1852-1875).
[58] Stichting tot instandhouding, *Jaarboekje* (1853)
[59] Stichting tot instandhouding, *Jaarboekjes* (1866-1875)
[60] 'De Volharding', accessed 5 February 2021, http://www.artis.nl/nl/ontdek/collectie/de-volharding/.
[61] Ibidem ; 'Registers der Geschenken'

I have therefore looked at exhibitions hosting minerals in the proximity of *Artis* that hosted materials of *Artis* or held close connections to *Artis* in other ways. These serve as an example of how the minerals might have been exhibited in *Artis.*

In studying all these magazines, books and on site-activities I have found three regimes of nature in popular mineralogy in and around *Artis*, namely 'nature as order', 'nature as leisure' and 'nature as resource'. The first chapter will discuss the nature as order-regime which was mainly present in sources before 1870. At the end of nineteenth century, following the nature as order-regime, the nature as leisure-regime becomes more dominant in popularising mineralogy. The second chapter will discuss in more detail how this shift in regimes elapsed and what nature as leisure exactly entailed. Lastly, the nature as resource-regime is discussed. Whereas the first two regimes are bound to certain periods of time, the nature as resource-regime is present in almost all the sources in the 100 years I have studied. This appears to be the case, in part, because of the lack of minerals in the Dutch soils.

NATURE AS ORDER

In his *Boek der Natuur* (1850), Friedrich Karl Ludwig Schoedler advices his readers to craft 3D-models of minerals from papier-mâché.[62] Another populariser of mineralogy recommends carving models out of soap or potatoes using a simple kitchen knife.[63] The crafting of models was meant to help the readers gain a better understanding of the complex crystal structures of minerals and the geometrical formulas that described them. The models illustrated an orderliness in nature. Therewith, the crafty exercise also exemplifies the nature as order-regime in popular mineralogy. According to Elizabeth Emma Ferry, this regime portrays 'a view of nature as a set of laws knowable through techniques, such as observation, comparison and classification'.[64] Moreover, the nature as order-regime is closely linked to ideas on 'pure' science wherein nature operates through physical laws, the study of which is a worthy goal in itself. I argue that the nature as order-regime is the same regime of nature that governs mineralogists and other 'old' natural historians in their search for the best classificatory systems. In case of the crystal structure models, the geometrical formulas were presented as natural laws. [65] These laws, in turn, functioned as the rules by which to order mineralogical specimen in a taxonomic scheme.

The nature as order-regime is most prominently present in the popular books on mineralogy before 1870 hosted by the library of *Artis Natura Magistra* (*Artis*).[66] In the first part of the chapter, I will discuss three books that mainly teach about classifying minerals and the orderliness of nature. Herein, minerals are presented to obey certain physical laws that ought to be discovered through extensive research. Secondly, I will discuss two books in more detail that stand out for their physicotheological purport. In physicotheology, nature and the natural laws according which nature operates were thought to be created by God. The study of nature would lead to a better understanding and worship of Creation.[67] Physicotheology, therewith, increased the relevance and appeal of mineralogy for the general audience. In the third section, I will look at crystal structures in popular mineralogy again. Although the nature as order-regime was most prominent before 1870, it can still be recognized in later sources. Especially the beautiful crystal structures remained a popular

[62] Friedrich K. L. Schoedler, *Boek der natuur: algemeene beginselen der physica, astronomie, chemie, mineralogie, geologie, physiologie, botanie en zoologie* (Utrecht: Dannenfelser en Doorman, 1850), 399.
[63] C.H. T. Jr., 'Over het onderwijs in de mineralogie', *De tijdspiegel*, no. 27 (1869): 16–18, 16.
[64] Elizabeth Emma Ferry, '"Ziegfeld Girls Coming Down A Runway": Exhibiting Minerals at the Smithsonian', *Journal of Material Culture* 15, no. 1 (March 2010): 30–63, https://doi.org/10.1177/1359183510355224., 39.
[65] Schoedler, *Boek der Natuur,* 399 ; T. Jr., 'Over het onderwijs in de mineralogie', 16.
[66] H. C. van Hall, *Redevoeringen over de geologie en delfstofkunde* (Groningen: Oomkes, 1840) ; Schoedler, *Boek der natuur* ; Franz von Kobell, *De mineralogie: populaire voordragten* (Breda: Broese & Comp., 1868).
[67] Kees de Pater, 'Christendom En Natuurwetenschappen in Historisch Perspectief', *Philosophia Reformata* 73, no. 1 (29 November 2008): 5–18, https://doi.org/10.1163/22116117-90000427.

means to illustrate nature as forming and functioning according to a set of laws. Lastly, I will look at how these works were received by contemporary reviewers and later popularisers of mineralogy. The main point of criticism on the works appears to be the lack of accessibility of this treatment of the subject for a broad audience.

'Nature as order' illustrated

This section will discuss three books on popular mineralogy that propagate a strong nature as order-regime. In these works, nature is thought to exist as a set of laws that can be discovered through a close study of nature. I will discuss the books in chronological order.

Van Hall - *Speeches on Geology and Mineralogy* (1840)

The oldest work is professor Herman Christiaan van Hall's *Redevoeringen over de Geologie en Delfstofkunde* from 1840.[68] Van Hall's work consists of ten chapters. It contains six chapters on geology and the last three are solely focussed on mineralogy.[69] It cost three guilders. When converting this price to current purchasing power in euros, according to the scheme of economic historian Arthur van Riel, it would be priced at around €29 today.[70] Therewith, it was available to an upper middle class audience. This is the same audience that had access to *Artis.*[71] Van Hall argued that this audience would benefit from a general discussion of the matter and not be appreciative of too detailed information. [72]

Van Hall grew up in Amsterdam and went to study medicine in Utrecht.[73] In 1828 he obtained his doctorate in Leiden and went back to Amsterdam again to practice medicine. His book contains a series of ten speeches held at the Genootschap ter Bevordering der Natuurkundige Wetenschappen te Groningen (Society for the Promotion of the Natural Sciences of Groningen). The book forms the last part of Professor J.A. Uilkens' published speeches called *Perfections of the Creator Considered in His Creatures, for the Glorification of God and for the Advancement of Physical Knowledge.*[74] Uilkens' work

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[68] Hall, *Redevoeringen over de geologie en delfstofkunde*.
[69] Hall, *Redevoeringen over de geologie en delfstofkunde*.
[70] Arthur Van Riel, 'Constructing the Nineteenth-Century Cost of Living Deflator (1800-1913)', accessed 16 February 2021, http://www.iisg.nl/hpw/brannex.php.
[71] Donna C. Mehos, 'Structuring a New Generation's Scientific Society', in *Science and Culture for Members Only: The Amsterdam Zoo Artis in the Nineteenth Century* (Amsterdam: Amsterdam University Press, 2005), 21–33, https://doi.org/10.1515/9789048503810, 24-28.
[72] Hall, *Redevoeringen over de geologie en de delfstofkunde,* vii-viii. 'voor wie een te diep indringen in eenige deelen der wetenschap ligt tot onoverkomelijke bezwaren aanleiding kon geven.'
[73] A.J. Van der Aa, 'Herman Christiaan van Hall', in *Biographisch woordenboek der Nederlanden. Bijvoegsel*, ed. J.J. Van Brederode (Haarlem: DBNL, 1878), https://www.dbnl.org/tekst/aa__001biog25_01/colofon.php.
[74] onbekend, 'De Volmaaktheden van Den Schepper in Zijne Schepselen Beschouwd in Redevoeringen, Ten Vervolge Op de Redevoeringen van J.A. Uilkens, Door H.C. van Hall. Vde Deel. Natuurlijke Geschiedenis. Geologie En Delfstofkunde. Te Groningen, Bij J. Oomkens. 1840. In Gr. 8vo. XVI En 275 Bl. (En Een Algemeen Register over al de Vijf Deelen, 24 Bl.) f 3', *Vaderlandsche Letteroefeningen*, 1841, https://dbnl.org/tekst/_vad003184101_01/_vad003184101_01_0032.php.

discussed the first two kingdoms of nature, botany and zoology, but also the natural sciences astronomy and meteorology. According to a review in a popular magazine of the time called *Vaderlandsche Letteroefeningen*, the works by Uilkens were very well received by a big audience.[75] However, Uilkens passed away before he could finish his series. Van Hall was Uilkens' successor as professor of botany and agrarian studies at the university of Groningen. Uilkens had asked Van Hall to write the last book on non-living nature to finish the series. The fact that Uilkens insisted that a last chapter on non-living nature would appear, indicates that mineralogy was still seen as a third part of the traditional natural history around 1840.

In his introduction, Van Hall immediately acknowledges the lack of appeal that rocks might have compared to animals and plants.[76] Yet, he is determined to show why the study of non-living nature is interesting also. One of the reasons Van Hall provides, is the fact that this kingdom is so little known by the general public that there is still a lot to discover. His plea for why we should not overlook non-living nature in our study of nature, shows early traces of the rise of the popularity of living nature. Van Hall furthermore claims that the geological study of non-living nature possesses the most appeal compared to the mineralogical study. He states: 'But what gives life and beauty to this whole study is the becoming of the earth.'[77] In this quote, a rise of the popularity of geology can be observed. All in all, the study of non-living nature, consisting of both geology and mineralogy, is presented as an important third pillar of natural history.

Despite the bigger appeal of geology, Van Hall argues that getting to know the materials that the earth consists of should proceed guesses about the origins of the earth.[78] One should gain knowledge of different types of rocks through studying mineralogy before studying their role in the formation of the earth. Especially the high aesthetic value of some rocks, consisting of the regularities in their shapes and their extraordinary colours, was worth getting to know. In Van Hall's discussion of mineralogy, we can observe a strong nature as order-regime. He speaks of regularities in the shapes of rocks and even refers to them as fixed laws of nature. Van Hall states that all rocks 'deserve to be known and whose original formation is bound by fixed laws, in the regulation of which laws the all-wise hand of supreme Goodness must not disregard.'[79]

Chapter eight of Van Hall's work discusses the characteristics of minerals and different categorizations based on these characteristics.[80] Van Hall most of all stresses the immense multiplicity

[75] Ibidem
[76] Ibidem, 3-4
[77] Ibidem, 4
[78] Ibidem, 6-7
[79] Ibidem, 4 '… allezins verdienen gekend te worden en welker oorspronkelijke vorming aan vaste wetten gebonden is, in de regeling van welke wetten de alwijze hand der opperste Goedheid niet mogen miskennen.'
[80] Ibidem,

of characteristics that minerals exhibit.[81] The characteristics Van Hall discusses are, for example, the geometrical crystal structures and the chemical composition of rocks. Van Hall argues that this multiplicity in characteristics makes mineralogy is the hardest subject of natural history. Eighteenth- and nineteenth century mineralogists struggled to create a natural hierarchy between these characteristics to create the ultimate natural taxonomic scheme.[82] In addition to the multiplicity of characteristics, Van Hall shows that the study of these characteristics requires knowledge of mathematics and chemistry. It even requires laboratory material and skills. Animals and plants, in contrast, are much easier to discern from each other with just the naked eye compared to minerals. Creating order in this complex web of mineralogical characteristics was exhausting, Van Hall argues, saying: 'How material man exhausts himself to properly order matter itself, which is so immediately within his reach, and to give a good idea of that richness in his Arrangements!'.[83]

Schoedler - *Book of Nature* (1850)

The second book that shows a nature as order-regime is Friedrich K.L. Schoedler's *Boek der Natuur* or *Book of Nature* published in 1850.[84] The original publication was first launched in Germany in 1849. It was such a success that it was translated into Dutch a year later. The Dutch publisher Kruseman labelled the book as being very well sold in the Netherlands as well.[85] The book cost 7 guilders and 50 cents. Therewith, it was somewhat more expensive than the other books I have studied and less accessible for the middle classes. Yet, with 839 pages it was almost three times as big as the other works. On top of that, it not only discussed mineralogy but all of nature. Schoedler dedicated one of his six chapters to mineralogy.

The book starts with an introduction by the translator J.W. Gunning.[86] Gunning explains that it was Schoedler's wish to write a book on the natural sciences that would provide teachers with information on a large variety of topics. Gunning claims it is not a mainstream popular study book containing hands-on experiments, but mainly an overview of the different natural phenomena and their corresponding natural laws. It is thus a good example of a the nature as order-regime. Throughout the course of the book, however, the author does regularly refer to some experiments one could do at home to witness the phenomena described for oneself. In the chapter on mineralogy,

[81] Ibidem, 199-220
[82] Rachel Laudan, *From Mineralogy to Geology: The Foundations of a Science, 1650 - 1830*, Science and Its Conceptual Foundations (Chicago, Ill.: University of Chicago Press, 1987), 70-76.
[83] Van Hall, *Redevoeringen over de geologie en de delfstofkunde*, 214 'Hoe put de stoffelijke mensch zich uit, om de stof zelve, die zoo onmiddelijk onder zijn bereik ligt, behoorlijk te ordenen en een goed denkbeeld van dien rijkdom in zijne Rangschikkingen te geven!'
[84] Schoedler, *Boek der natuur*.
[85] Arie Cornelis Kruseman, *Bouwstoffen voor een geschiedenis van den Nederlandschen boekhandel: gedurende de halve eeuw 1830-1880* (P.N. van Kampen, 1887) 390.
[86] Ibidem, prologue.

Schoedler provides an experiment for testing the conductivity of metals for example. He tells his readers to rub a metal specimen with a piece of cloth and then hold it next to a piece of cork on a string.[87] If the cork moves away from the metal, it conducts electricity. For the exact phenomena and the corresponding physical laws at work, he refers the reader to his chapter on physics.

In his own introduction, Schoedler claims that nature consists of everything we can perceive with our senses. [88] In his book, he divides the study of nature into six sciences, namely physics, chemistry, physiology, mineralogy, botany and zoology.[89] Schoedler labels the first three sciences as the sciences of phenomena that study natural laws. The last three sciences are labelled as the sciences of objects, or in other words natural history. Natural history studies the materialization of the laws discovered in the sciences of phenomena. In its entirety, the book presents an overview of these different laws found by the sciences of phenomena and the enactment of these laws in natural history objects, including minerals. You can see an overview of Schoedler's classification of the natural sciences in figure 1.

A. WETENSCHAP DER VERSCHIJNSELEN.			B. WETENSCHAP DER VOORWERPEN.		
1. Zonder verandering der voorwerpen.	2. Met verandering der voorwerpen.	3. Aan levende voorwerpen.	4. Die door hunne geheele massa gelijkaardig zijn.	5. Die ongelijkaardig en zonder vrije beweging zijn.	6. Die ongelijkaardig en met vrije beweging begaafd zijn.
Physica.	**Chemie.**	**Physiologie.**	**Mineralogie.**	**Botanie.**	**Zoölogie.**

Figure 1 - The study of nature by Schoedler

Schoedler furthermore explains that phenomena exist of forces and causes that we need to learn by heart.[90] Studying phenomena, requires more senses than the study of objects and often uses technology to enhance these senses. Objects are more easily recognized and studied with the naked eye. The differences between animals and plants and minerals, according to Schoedler, is the absence of cooperative organs in minerals. These cooperative organs or heterogenous tissue are what brings life to animals and plants. Minerals are inorganic objects that have equal or homogenous masses. To illustrate the difference between living nature and mineralogy, Schoedler provides an example wherein chipping off a piece of rock from a mineral does not affect the rock much. When you chop of

[87] E.g. Schoedler, *Boek der Natuur*, 404.
[88] Ibidem, III-XVI.
[89] Ibidem, XI-XVI
[90] Ibidem, III-XVI.

the root of a plant, however, it will most probably die.[91] A key difference between chemistry and mineralogy, according to Schoedler, is the fact that 'mineralogy is nothing but the study of the various chemical compounds occurring in nature.'[92] Chemistry is the study of phenomena accompanied by changes of substances used in an experiment or in another particular situation. Minerals are not studied as dynamic phenomena, but static objects shaped by these phenomena. Schoedler's chapter on mineralogy therefore builds on his chapter on chemistry.[93] He often refers to physical laws previously stated in his chapter on chemistry.

About half of Schoedler's chapter on mineralogy is on geognosy and geology.[94] These subjects are still deemed subdisciplines of mineralogy by Schoedler. As mentioned in the introduction, these disciplinary boundaries changed during this period. By the end of the century mineralogy had become a subdiscipline of geology instead. In the chapters on living nature, Schoedler provides the taxonomic systems for animals and plants, but also the ways in which these grow and take up nutrients as researched in microscopic or physiological research. He does not treat any behaviours or interactions between organisms. In sum, therefore, Schoedler's book can be said to be a disciplinary hybrid that illustrates the shifting disciplinary boundaries around 1850. He presents the traditional or old-fashioned disciplines of natural history including mineralogy. Yet, he also incorporates the modern physiological research in the chapters on botany and zoology.

Schoedler suggests that there is no right order in which to learn about the different subjects, but he does give advice on how to start.[95] The 'mature mind' would benefit from learning about the phenomena and general laws first, because almost all of the objects are subject to these phenomena and laws. The study of objects would then be easier to understand afterwards. He therefore advises adults to study the subjects in the order of his book. Children, however, are not yet capable of understanding abstract phenomena and laws before the age of 15, Schoedler argues. He therefore advises primary school teachers and parents to teach their kids about nature in the reverse order of the book. Children tend to have more attention for the tangible parts of nature than for abstract phenomena. This strongly suggests that the nature as order-regime is something that can only be taught to the public at a later age.

The first thing we want from mineralogy, Schoedler claims, is a taxonomy.[96] These taxonomies are based on three types of characteristics, namely their shape, their physical characteristics and their chemical composition. The shape of minerals is determined by their crystal structure. It is the

[91] Ibidem, XII
[92] Ibidem, 394
[93] Ibidem, 393-410
[94] Ibidem, 411-517
[95] Ibidem, XVI-XVII
[96] Ibidem, 393-410

characteristic that is most easily discernible for amateurs because it can be observed with the naked eye and optionally a goniometer. Schoedler provides pages full of schematic images of crystal structures to recognize and categorize minerals. As we have seen, Schoedler advises his readers to make 3D-figures from these images to get a better feel for the structures using papier-mâché.[97] However, he argues, it would be best to buy a small collection of rocks for beginners. These were available for a decent price just across the German border, the translator Gunning suggests.

The physical characteristics of rocks are more difficult for amateurs to research compared to their shapes. Schoedler discusses the physical characteristics in the order of well-executable for amateurs to less executable. Examples of physical characteristics of minerals described are the density, the light-refracting attributes and whether the materials were magnetic or conducted electricity.[98] In his explanation of these characteristics he often refers to phenomena and laws discussed in previous chapters. For some of the characteristics Schoedler provides simple experiments one could do at home. Lastly, Schoedler suggests that chemical analysis of the rocks is your last resort to discern minerals from each other if the crystal structures and physical attributes did not provide decisive information. The amount of experiments one could do at home drops in this paragraph because it requires too much specialized knowledge and material. Schoedler does discuss quite extensively how one could use a blowpipe to test if the mineral melts at high temperatures.[99] With the use of a blowpipe one can also see what colour flame the material gives.

The rest of the chapter on mineralogy, provides an elaborate taxonomic overview of the different types of minerals in nature.[100] The categories are based on the characteristics described above. The taxonomic system used is one that is best understood and attainable by amateurs through their own research. Since it is based on the enactment of physical and chemical laws in the objects, it presents a nature as order-regime. Considering the fact that Schoedler's book was written as an overview of laws and enactment of laws, the nature as order-regime prevails throughout Schoedler's entire book.

Von Kobell - *Mineralogy: Popular Speeches* (1868)

The most recent book that I studied that has a dominant nature as order-regime is Franz von Kobell's *De Mineralogie: Populaire Voordragten.*[101] Like the *Boek der Natuur,* Von Kobell's work was originally only published in German. It was translated into Dutch by H.M.D. van Riemsdijk. A review of the work in the popular magazine *De Tijdspiegel* stated that the German works of Van Kobell were so generally

[97] Ibidem, 399
[98] Ibidem, 400-410
[99] Ibidem, 406
[100] Ibidem, 411-449
[101] Franz von *Kobell*, *De mineralogie: populaire voordragten* (Breda: Broese & Comp., 1868).

known that this work needed no recommendation.[102] Von Kobell had published a lot of popular works for amateur mineralogists in Germany. These were apparently well-known and -consumed in the Netherlands too. According to the review, the price of the book made it accessible to a broad middle class audience. Considering it is a 279-page book with 67 pictures printed on high quality paper, it was even described as a good deal.

The book consist of five chapters.[103] The first chapter is dedicated to what minerals are and what different characteristics they possess. The definition of a mineral is similar to that of Schoedler's. Minerals are inorganic natural products that have equal masses.[104] They do not possess any cooperative organs and take part in the formation of earth. According to Von Kobell, minerals possess physical and chemical characteristics. The most important physical characteristic in mineralogy, he argues, is the shape of the specimen that is determined by the crystal structure of the mineral. Von Kobell dedicates thirty pages on crystallography in which a nature as order-regime is expressed.[105] His explanation of the crystal figures is quite technical and supported by drawings. He reduces the patterns of crystal structures to four mathematical 'laws' and six basic shapes.[106] From these six basic shapes, all crystal structures that appear in nature can be constructed. Figure 2 shows the different shapes that occur in the first 'tesseral' system.Von Kobell argues that while humans built rather arbitrarily '… nature conforms to certain laws in the formation of crystals.'[107]

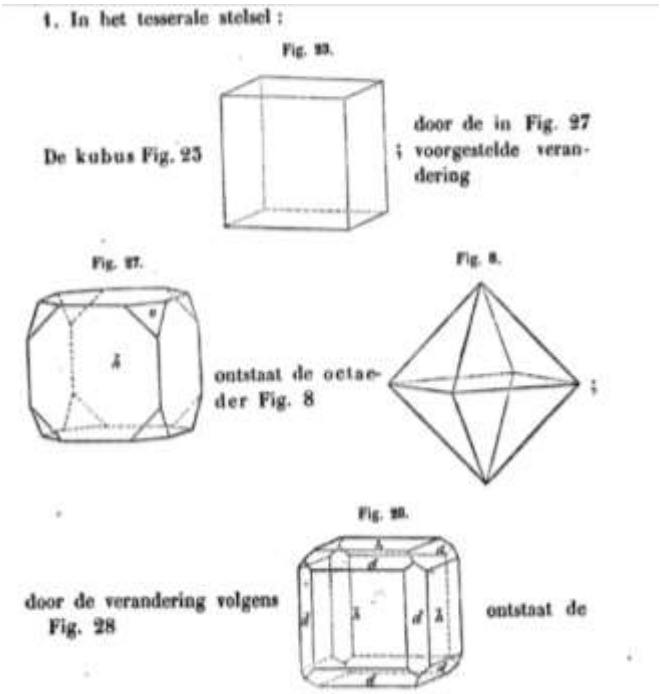

Figure 2 - Crystal structures from the tesseral system

Von Kobell's reviewer was especially pleased with Von Kobell's explanation of the crystal structures and the accompanying drawings.[108] The pages were deemed very helpful in classifying one's specimen. Another useful addition this edition provides, the reviewer claims, is a

[102] Ibidem, 16-18
[103] Ibidem
[104] Ibidem, 1-2
[105] Ibidem, 2-32
[106] Ibidem, 15-18
[107] Kobell, *De mineralogie*, 5 'terwijl de natuur zich bij het vormen der kristallen voegt naar zekere wetten,..'
[108] C.H. T. Jr., 'Over het onderwijs in de mineralogie', *De tijdspiegel*, no. 27 (1869): 16–18.

table on the nomenclature of rocks in Dutch, German and French. This also made classifying rocks with the help of books on mineralogy in German and French easier for the amateur. The reviewer argued that Von Kobell gives dead nature 'a soul' to spark peoples interest without vulgarising the study of mineralogy.

The other characteristics that Von Kobell discusses are for example their electric conductivity, magnetic properties, iridising and phosphorescing, but also their scent and taste.[109] Since these characteristics are hard to understand and uncover he advises his readers to take up chemistry. Only with a qualitative chemical analysis will you be able to classify minerals properly, Von Kobell argues. However, by using a blowpipe in which minerals can be subjected to very high temperatures a lot of minerals will unveil themselves.[110] Von Kobell provides a list of effects that these high temperatures have on certain minerals. Maganese ores will for example turn spark violet flames.

Lastly, Von Kobell provides a taxonomic scheme based on the characteristics he described above in his introduction. In the following chapters, Von Kobell discusses a variety of minerals according to this system. Herein, he not only treats their physical and chemical characteristics, but also their etymology, how they are used in daily life and more.[111] The first chapter is dedicated to gems and the second to 'normal' rocks. In a similar matter, the third chapter discusses the noble metals and the fourth the 'normal' metals. Von Kobell, like Van Hall, recognizes the difficulty in constructing one perfect taxonomic system that takes all mineralogical characteristics into consideration. He states:

> 'It is as if nature is only reluctant to give us a glimpse into her workshop; as if the matter should not be made all too easy for us to exercise our understanding, and so she has invented obstacles of all kinds, … .'[112]

Herein, Von Kobell argues that nature is unwilling to give away her construction methods of minerals and the logic behind them. Therewith, developing an ideal or true taxonomic system seems unattainable. The wish to create an ideal taxonomy by uncovering the laws of nature of Van Hall and Von Kobell, is motivated by their so-called physicotheological view of nature. In physicotheology, nature is thought to be the product of Creation and the laws in nature as instilled by God. The nature

[109] Ibidem, 39-43
[110] Ibidem, 43-47
[111] Ibidem, 52-279
[112] Ibidem, 26 'Het is alsof de natuur ons slechts ongaarne een blik in hare werkplaats gunt; alsof de zaak ons, tot oefening van het verstand, niet al te gemakkelijk gemaakt moet worden, en zoo heeft zij hinderpalen van allerlei aard uitgevonden, die evenwel door onderlinge zamenwerking van vele natuuronderzoekers gedeeltelijk zijn uit den weg geruimd, …'

as order-regime of Van Hall and Von Kobell lean heavily on these physicotheological ideas. The next section will discuss the relation between the regime and physicotheology in more detail.

Mineralogical laws and Creation

Physicotheology was especially prominent in eighteenth-century popular works on nature.[113] Eighteenth-century authors tried to show their readers the existence of God through their natural knowledge. They encouraged the public to study nature themselves to get to know and appreciate the greatness of the Creator. In some of the popular mineralogical books and articles that I have studied, a continuation of this physicotheological view of nature is present. What is striking in the works by Van Hall and Von Kobell is their physicotheological tenor in combination with the nature as order-regime. There appears to be a relation between physicotheology and the nature as order-regime, but not a necessary one as testifies from the non-physicotheological work of Schoedler. Both this tenor and regime are much less present in the works after 1870 that I studied.

I have shown that Van Hall's work propagates a nature as order-regime because he wrote about nature forming and functioning according to natural laws. On top of that, Van Hall argued, that these laws were installed by God during Creation. Uncovering these laws by the close study of nature would therefore bring a better understanding and appreciation of the Creator. In support of this argument, Van Hall states that the study of minerals is suited 'to sharpen ingenuity, to purify judgment, to exercise memory, to get to know interrelationships between all created things in order to understand and worship Creation.'[114] Van Hall has also contributed an article in the first edition of the *Album der Natuur* in 1852.[115] This article has as its title 'Balance in nature'. In this article Van Hall presents a similar physicotheological argument. He argues that all of nature operates in such a delicate balance that nature must therefore be governed by natural laws installed by the Creator.

In his book, Van Hall takes this physicotheological argument further by claiming that the study of mineralogy will provide you with most knowledge and appreciation of Creation compared to the study of botany or zoology for example. In living nature, he argues, the phenomenon of life itself demonstrates the creation of a higher power. In the mineral kingdom, it is the immense complexity of characteristics that shows the interference of a divine being.[116] Mineralogy will make you even more appreciative of Creation compared to the study of animals or plants, Van Hall argues, because minerals were the hardest part of nature for humans to systematize.[117] All in all, Van Hall shows that

[113]Pater, 'Christendom En Natuurwetenschappen in Historisch Perspectief'.
[114] Ibidem, 214 '… vernuft op te scherpen, oordeel te zuiveren, geheugen te oefenen, onderlinge betrekkingen tussen al het geschapenen leren kennen om de schepping te snappen en vereren.'
[115] H.C. Van Hall, 'Het Evenwicht in de Natuur', *Album Der Natuur*, 1853, 21–38.
[116] Ibidem, 214
[117] Ibidem, 201 & 214

mineralogy is a tough exercise for the mind that will bring one insight and admiration for the Creator in return. This way, Van Hall uses physicotheology as a motivation for his readers to study mineralogy.

In Von Kobell's work, the order as nature-regime also leans on a physicotheological view of nature.[118] It is assumed that nature, including the natural laws governing nature, were installed by a Creator. In contrast to Van Hall, however, the study of nature is no longer seen as a means to better understand Creation, but only to be humbled by the complexity and beauty of everything created.[119] According to Von Kobell, naturalists should no longer strive for or claim to have found the ideal mineralogical taxonomic scheme as installed by the Creator. He argues that those who claim to have found an ideal way of ordering nature have no understanding of the vastness of Creation, stating:

> 'As for those, who think themselves masters of the castle when they have merely entered a court, they only prove that they have no conception of the magnitude of nature, and only keep it as great as their understanding can comprehend, or rather, for as small as they are themselves.'[120]

Von Kobell's four laws and six basic figures to order minerals by that I discussed earlier should be seen as best-estimations of the Creators laws of nature, according to Von Kobell.

Whereas Van Hall uses his physicotheological view of nature as a motivation to get a better understanding of nature, Von Kobell mainly uses physicotheology as a moralising tool. This development has also been observed by Bert Theunissen in his study on the *Album der Natuur* and Kees de Pater's research on physicotheology in popular works in the Netherlands. After 1850 Dutch physicotheological works became increasingly moralising.[121] The assumption that nature is created by a higher being no longer functioned as a motivation to understand Creation, but as an explanation for the position of the human in nature and how humans should treat nature. In his second chapter, Von Kobell, for example, discusses the gems as one category of minerals. Von Kobell calls gems the 'delights of inorganic creation that glitter the crowns of princes and the treasuries of the rich.'[122] According to him, gems are the most popular minerals to study because of their beauty. We should not admire gems just for their beauty, however, because they are more than mere showpieces.[123] Vanity is presented as a vice.

In short, the physicotheological view of nature and the nature as order-regime often went

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[118] E.g. instances where Von Kobell refers to nature as Creation in Kobell, *De mineralogie*, 75, 107, 152 & 172
[119] Ibidem, 26
[120] Ibidem, 26 'Wat hun echter aangaat, die zich reeds meester van het kasteel wanen, wanneer zij een voorhof zijn binnengedrongen, zij bewijzen slechts, dat zijn geen begrip van de grootte der natuur, en haar slechts voor zoo groot houden, als hun verstand haar kan omvatten, of beter gezegd, voor zoo klein als zij zelve zijn. '
[121] Bert Theunissen, 'Natuursport en Levensgeluk: Hugo de Vries, Eli Heimans en Jac. P. Thijsse', *Gewina* 16 (1993): 287–208, 295 ; Pater, 'Christendom En Natuurwetenschappen in Historisch Perspectief'.
[122] Ibidem, 107 'En hiermede besluit ik het kort overzigt van deze heerlijkheden der anorganische schepping die de kroonen der vorsten en in de schatkamers der rijken schitteren, …'
[123] Ibidem, 66-71

hand-in-hand but not necessarily so. The idea in the nature as order-regime that nature is made up of natural laws was supported by the physicotheological idea that nature and natural laws were created by a higher being. Van Hall first of all argued that the study of mineralogy by extracting natural laws, would lead to a better understanding of Creation and God. He used this argument as a motivation for his readers to study mineralogy. Secondly, he argued that the difficulties one would encounter in formulating natural laws testified of the intervention of a higher being and should lead to an appreciating of Creation. Von Kobell also expressed this second argument of Van Hall, but renounced the idea that naturalists were capable of formulating true natural laws of taxonomies. Von Kobell used physicotheology primarily as a moralising tool like many other popularisers of nature after 1850. The decrease of works propagating the nature as order-regime and the physicotheological view of nature around 1870 coincided.

Crystal structures

The nature as order-regime, however, never disappeared entirely from the popularising activities that I have studied. As Pablo Escobar emphasizes, regimes of nature can overlap and coexist next to each other in time and place.[124] Whereas I observed that the nature as order-regime declines in written works after 1870, the regime remains present in on-site activities throughout the entire period that I have studied. Van Hall, Schoedler and Von Kobelll all relied heavily on the impressive crystal structures in expressing a nature as order-regime. These crystal structures also lend themselves very well in material form in on site-activities for expressing nature as order. I have come across a few examples that I will share. However, they are small in number in and around *Artis.*

We have already come across the first example of a mineralogical on site-activity in the works Schoedler and Von Kobell.[125] They encouraged their readers to make their own 3D-crystal structure figures out of papier-mâché, potatoes or soap as a fun activity and to get a better understanding of the structures. From *De Levende Natuur*-magazine we learn that these 3D crystal structure models could also be bought.[126] *De Levende Natuur* gave a monthly overview of the different products the public could buy to enhance their own studies of nature. In 1905, this section includes an advertisement for different books and objects for the study of mineralogy, including rocks and crystal structure models. This example shows that the crystal structures that were often referred to in written works prior to 1870, were still studied in the early twentieth century.

[124] Arturo Escobar, 'After Nature: Steps to an Antiessentialist Political Ecology', *Current Anthropology* 40, no. 1 (February 1999): 1–30, https://doi.org/10.1086/515799, 5
[125] Schoedler, *Boek der natuur*, 399 ; T. Jr., 'Over het onderwijs in de mineralogie', 16.
[126] J. Jaspers, 'Inlichtingendienst Ruilverkeer Natuurhistorische Vereeniging', *De Levende Natuur*, no. 10 (1905): 45.

Artis also possessed 3D crystal structure figures.[127] *Artis* has always received a lot of gifts from beneficiaries. They have kept close track of these gifts in their administration but also in the appendix of a series of booklets they published between 1852 and 1875 called the *Jaarboekjes* or *Yearbooks.* In these sources I have found that *Artis* regularly received minerals and on one occasion also crystal structure figures. In 1852, F. van Heukelom had given a skull of a small monkey and a collection of crystal structure models in carton with an explanation of the models. According to the information in the *Yearbook*, these objects went to the Natural History Museum or Groote Museum on *Artis'* grounds. Sadly, I have not been able to find if the out models were ever on display and if so, in what context.

From examples of other museums with mineralogical collections, however, we learn that it was common practice for museums to exhibit crystal structure models next to actual minerals in taxonomic systems, representing nature as order. The nature as order-regime was coined by Ferry based on her research of the mineralogical cabinet of the Smithsonian Institute.[128] The exhibitions Ferry studied are an example of mineralogical on site-activities. She describes how part of the mineral collection was exhibited with the crystal structure as the primary characteristic to categorize the objects. The minerals on display were the representatives of other minerals that have a similar crystal structures. A well-known example of the nature as order-regime in on site-activities in the Netherlands that also used crystal models was Teylers Museum in Haarlem, nearby Amsterdam.[129] Teylers Museum bought a collection of 597 crystal models made form pear wood between 1802 and 1804. The models were made by the famous French mineralogist René Just Haüy. The conservator of Teylers Museum, Martinus van Marum, used the models to rearrange the collection of minerals. The models accompanied the minerals in the final exhibition.

From a report on a visit to the Natural History Museum in London in 1903 in *De Levende Natuur,* it appears that the Natural History Museum also contained this type of mineralogical exhibition.[130] The author of the report, mr. L. Cz. Dorsman was very pleased with this particular exhibition. He states that in the Crystal Room of the museum: 'an overview is masterly given of the classification of the minerals, their properties etc. etc., all illustrated by the most typical examples, and

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[127] Stichting tot instandhouding van de Diergaarde van het Koninklijk Zoölogisch Genootschap Natura Artis Magistra, *Jaarboekje van het Koninklijk Zoölogisch Genootschap 'Natura Artis Magistra'*, vol. 6 (Westerman, 1857) 92

[128] Ferry, '"Ziegfeld Girls Coming Down A Runway", 39-43

[129] W. Saeijs, 'Haüy's Kristalmodellen in Teylers Museum', *Grondboor & Hamer* 57, no. 1 (1 January 2003): 12–16, https://natuurtijdschriften.nl/pub/406062.

[130] L. Cz. Dorsman, 'Wat Er Voor in Londen Voor Een Natuurliefhebber Te Zien Valt.', *De Levende Natuur* 11, no. 9 (1906): 170–73, 172-173. 'Zoo wordt de zaal der kristallen ingeleid door een collectie getiteld : „Introductie tot de studie der mineralogie", waarin op meesterlijke wijze een overzicht gegeven wordt van de indeeling der mineralen, hunne eigenschappen enz. enz., alles geïllustreerd door de meest typische voorbeelden, en zóó voldoende toegelicht, dat zelfs een leek geheel voldaan deze mooie verzameling verlaat.'

so sufficiently explained, that even a layman leaves this beautiful collection completely satisfied.'

Mineralogical collections in museums lend themselves really well for visualizing the nature as order-regime. By sorting the minerals according to their crystal structure, the exhibition as a whole will illustrate the laws of nature that govern the forming of minerals in a beautiful way. These exhibitions are not restricted to the period prior to 1870 but stretched well into the twentieth century. Although I have not been able to find any clues as to in what ways *Artis* exhibited its collection of minerals and crystal models, the examples of other museums illustrate that it was common practice to exhibit them according taxonomic systems representing nature as order.

The issue of accessibility

Except for the crystal structure models and exhibitions, the nature as order-regime declines in popular mineralogy after 1870. The regime leaned heavily on the 'old' classificatory natural history. After 1870 one can see the rise of the 'new' natural history and popular geology accompanied by the nature as leisure-regime that I will discuss in the next chapter. Judging from the works themselves and the later nature as leisure-authors, an important reason for the decline was a poor accessibility of popular mineralogy in the nature as order-regime.

The poor accessibility of popular mineralogy wherein classification and natural laws were central topics, was already addressed in the works of Schoedler and Von Kobell themselves. In Schoedler's book, for example, the translator J.W. Gunning advices the reader to buy a small collection of rocks for self-study just over the border in Germany for a decent price.[131] Apparently, the mineral collections in the Netherlands were expensive. Yet, to buy a collection of minerals for your studies, you would have been required to have the means to travel to Germany first. Another issue that was addressed by Von Kobell and Schoedler is the knowledge on geometry and chemistry and chemical instruments required to properly classify your specimen. Both literature on these subjects and chemical instruments were costly goods that one ought to buy to learn more about the subject in the nature as order-regime.

This lack of accessibility was restricted to financial or intellectual means, but also the entertainment value of the regime was criticized. Van Hall's book, for example, was not as well received as Uilken's works that it was supposed to complement.[132] A reviewer of Van Hall's book claims that the work is simply inferior to the previous work by Uilkens. The reviewer comments that Van Hall, in his chapters on minerals, merely presents a short recital of the different minerals in the

[131] Schoedler, *Boek der natuur*, 399

[132] onbekend, 'De Volmaaktheden van Den Schepper in Zijne Schepselen Beschouwd in Redevoeringen, Ten Vervolge Op de Redevoeringen van J.A. Uilkens, Door H.C. van Hall. Vde Deel. Natuurlijke Geschiedenis. Geologie En Delfstofkunde. Te Groningen, Bij J. Oomkens. 1840. In Gr. 8vo. XVI En 275 Bl. (En Een Algemeen Register over al de Vijf Deelen, 24 Bl.) f 3', 113-115

earth's crust. This recital was only interchanged by short and often unclear sentences on the order and cohesion of the universe. Uilkens' work was much more pleasant to read due to his references to lively travel reports, poetry and prose, according to the review. In contrast, the reviewer shows his annoyance with Van Hall's incapability of transferring his passion for rocks, stating: 'It is especially troublesome to see the author so often enraptured in a kind of delight which the hearers of his speeches, or at least the readers, cannot share.'[133]

Criticism on the accessibility of the nature as order-regime was also voiced by later popularisers of mineralogy that operated in different regimes. We need to treat this criticism more carefully, however, since its main function was to show how their own approach is an improvement relative to the nature as order-regime. One illustrative example of this can be found in dr. Tiberius Cornelis Winkler's *Schatten van den Aardbodem* or *Treasures of Earth* published in 1870. In his introduction, Winkler states: 'It is not a dull textbook of minerals that I am offering here to the friendly reader. They are not dry tasks of chemical and crystallographic formulas that you will find in my book.' [134] Here Winkler refers to the types of books that I have mentioned in the previous parts of this chapter. He argues these books filled with crystallographic structures and formulas were incredibly boring.

For the first few years, *De Levende Natuur* did not publish anything on mineralogy or geology. This is not strange considering the fact that the title of the magazine suggests that its articles are about living nature. In 1909 Eli Heimans decided to write a first article on geology since, traditionally, rocks and minerals are part of nature.[135] After Heimans many authors succeeded him in writing articles on non-living nature too. Most authors of these articles contrasted their work to 'old' mineralogy and boring nomenclature and crystal structure formulas.[136] Coming from followers of the nature as leisure-regime, I cannot say with certainty that the public indeed broadly associated mineralogy with boring nomenclature and difficult crystallography and if this association was a bad one. The next chapter on the nature as leisure-regime will discuss how these works popularised mineralogy.

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[133] Ibidem, 115 'Vooral is het hinderlijk, den Schrijver zoo dikwerf in eene soort van verrukking te zien gebragt, die de hoorders zijner Redevoeringen, of althans zeker de lezers niet deelen kunnen.'

[134] T. C. Winkler, *De schatten van de aardbodem* (Kruseman, 1870) 2. ''T is geen dor leerboek der delfstofkunde 't welk ik hier den vriendelijken lezer aanbied. 't Zijn geen drooge opgaven van scheikundige en kristalllographische formules die gij in mijn boek zult vinden.'

[135] Eli Heimans, 'Gesteenten', *De Levende Natuur* 14, no. 1 (1909): 6–9, 6

[136] See e.g. D.J. Van der Ven, 'Neerlands Thüringen', *De Levende Natuur* 15, no. 7 (1910): 125–31, 125 ; J.A.J.M. Van Waterschoot van der Gracht, 'Schetsen Uit Een Zeer Ver Verleden', *De Levende Natuur* 15, no. 3 (1910): 45–49, 45.

NATURE AS LEISURE

In his *Keienbook*, or *Boulder book,* Pieter van der Lijn lists what materials you should bring when going into nature to collect rocks.[137] These materials include wrapping materials such as cloths or flasks to prevent your rocks from damaging each other in your backpack. It was also necessary to carry a hammer or pickaxe on your collecting trip. With the tools you could break off a smaller piece of rock from a larger entity or inspect the insides of rocks. Moreover, you should always carry a pen and paper to label your rocks. It was very important to register the location of where you found the rock. Van Lijn's practical guide that encouraged the public to go out into nature themselves is a typical example of the second regime of nature that can be recognized in popular mineralogy: nature as leisure.

The 'nature as leisure'-regime is a regime I termed myself. The nature as leisure-regime is a view of nature as an enjoyable activity by going outdoors for an attentive walk or spending time on creating one's own collection of natural specimens. This regime can be recognized following the nature as order-regime from the previous chapter. The view of nature as something to enjoy gains big popularity in the 1890s, especially in the popularisation of the 'new' natural history. This new natural history mainly focussed on living nature. In this chapter I will show that several attempts have been made to popularise minerals in a similar manner. Not by arguing that minerals are alive, but in other more creative ways with the minerals at hand for a broad audience living in Amsterdam or elsewhere in the Netherlands. I have not found any on-site activities that held this regime, so the examples I provide are from written sources only.

As I have mentioned in the introduction, the study of natural history increasingly came to mean the study of living nature during the nineteenth century. Natural history took a practical turn in which organisms were studied in their natural environments for their behaviour and interactions. In *Worlds of Natural History,* Lynn Nyhart explains that natural history reformers had sought 'to enliven natural history and make it accessible for a broad audience.'[138] This broad audience was reached by building natural history museums and zoos in the city centres. *Artis Natura Magistra,* hosting several museums on the same grounds as its animal enclosures, is a good example of this development. Other reformers reached their audience by writing about nature in popular books and magazines. Herein, reformers would often encourage their readers to interact with nature themselves too. Natural history became a pursuable hobby.[139]

The first section of this chapter will discusss dr. Tiberius Cornelis Winkler's *Handboek voor den*

[137] P. van der Lijn, *Het Keienboek : Inleiding Bij de Studie Onzer Zwerfsteenen* (Zutphen : Thieme, 1923), 1-4.
[138] Lynn K Nyhart, 'Publics and Practices', in *Worlds of Natural History*, ed. Helen Anne Curry et al. (Cambridge: Cambridge University Press, 2018), 335–47, https://doi.org/10.1017/9781108225229 336.
[139] Ibidem, 336.

Verzamelaar or *Handbook for the Collector* (1880).[140] This handbook provides an overview of tips for collecting a variety of natural objects from minerals and shells to the plants and fish in aquaria. Winkler's tips mainly focus on creating complete taxonomic collections. Therewith, Winkler can be seen as a transitional figure that propagated both the nature as order- and the nature as leisure-regime. Since Winkler discusses both collecting living and non-living natural artifacts, interesting differences between collecting minerals and specimen of living nature appear is Winkler's book. Herein, we can observe the exclusion of mineralogy in the new natural history.

In the 1890s, the Amsterdam-based educators Eli Heimans and Jac P. Thijsse appeared as prominent reformers of this new natural history.[141] Heimans and Thijsse have written on nature for the Amsterdam and Dutch national audiences. They were frequent visitors of *Artis* and were involved in the creation of educational programs of the zoo. These gentlemen called their view of nature 'natuursport' or 'nature sports'. This sports-idea implies nature should be enjoyed for the sake of the game or activity.[142] Whereas Heimans and Thijsse first solely focussed on living nature in the new natural history style, in 1909 Heimans also started to get involved in popular mineralogy.[143] Many contributors of *De Levende Natuur* have followed suit with articles on mineralogy after him.[144] The second part of this chapter will discuss the natuursport-philosophy and the role of minerals in it. I will mainly refer to articles from *De Levende Natuur* in this paragraph.

Pieter van der Lijn was a frequent contributor of articles on geology and mineralogy.[145] His work will be discussed elaborately in the last part the chapter. Van der Lijn had succeeded in circumventing the problem of bad accessibility of minerals to the Dutch audience. He focussed on assemblages of minerals in the form of boulders that could be found in the Dutch landscapes. In 1923, Van der Lijn also wrote his *Boulder Book* on erratic boulders for the amateur collector.[146] Van der Lijn dedicated the first chapter of his book to mineralogy for his readers to understand the composition of the boulders. In the works of Van der Lijn and other supporters of the natuursport-philosophy, the emphasis was usually on the historical or geological value of the rocks and boulders. The authors' end goal was usually telling more about the rock's role in the landscape's history, but basic knowledge of

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[140] Tiberius Cornelius Winkler, *Handboek Voor Den Verzamelaar: Een Praktisch Boek, Leerende Het Aanleggen, in Orde Maken En Onderhouden van Alle Soorten van Verzamelingen* (Sijthoff, 1880).
[141] Klaas van Berkel, 'Heimans En Thijsse En Het Boek Der Natuur', in *Citaten Uit Het Boek Der Natuur: Opstellen over Nederlandse Wetenschapsgeschiedenis* (Amsterdam: B. Bakker, 1998), 265–96.
[142] Berkel, 'Heimans En Thijsse En Het Boek Der Natuur', 266
[143] Eli Heimans, 'Gesteenten', *De Levende Natuur* 14, no. 1 (1909): 6–9.
[144] E.g. Eli Heimans, 'Mineralen', *De Levende Natuur*, no. 24 (1910): 563–66 ; P. Tesch, 'Een Geologische Wandeling', *De Levende Natuur* 15, no. 14 (1910): 265–70 ; J Hoeker, 'Over 't ontstaan van vuursteen', *De Levende Natuur* 30, no. 2 (1925): 41–51.
[145] E.g. Pieter van der Lijn, 'Schriftgraniet', *De Levende Natuur* 27, no. 5 (1922): 149–54 ; Pieter van der Lijn, 'Breksies Als Zwerfsteenen', *De Levende Natuur* 28, no. 5 (1923): 140–45 ; Pieter van der Lijn, 'Helleflinta', *De Levende Natuur* 41, no. 3 (1936): 74–78.
[146] Pieter van der Lijn, *Het Keienboek : Inleiding Bij de Studie Onzer Zwerfsteenen* (Zutphen : Thieme, 1923).

mineralogy remained essential in doing so. This ontological change of minerals that I have addressed in the introduction became very apparent.

Winkler's *Handbook for the Collector* (1880)

In this section, I will discuss dr. Tiberius Cornelius Winkler's *Handboek voor den Verzamelaar* or *Handbook for the Collector* (1880) as an early example of the nature as leisure-regime before the natuursport craze of the early twentieth century.[147] Winkler was born in 1822 in Leeuwarden as the son of a merchant and was raised to be a merchant too.[148] In 1852, Winkler moved to Haarlem with his family where he went to the Surgeon's School and was trained as a surgeon. While living in Haarlem, he became a regular visitor of the Teylers Museum and library there. He performed a lot of self-study and was appointed as the new conservator of the mineralogical and paleontological cabinet of Teylers Museum in 1864. His academic research mainly focussed on palaeontology, but he took his job in popularising science as a conservator very seriously too. His written popular output was tremendous. For example, he produced over fifty articles on natural history in the *Album der Natuur* and he also wrote several works on the zoological collections in *Artis.*[149]

In 1880, he translated the *Handbook for the Collector* from German into Dutch.[150] The book was directed at school boys. Yet, Winkler assures the reader that it will most certainly prove itself useful to other collectors as well. An article from *De Levende Natuur* in 1902 confirms this.[151] Herein, W.W. Kolvoort says it is the oldest book in his collection but he still consults it sometimes. The handbook presents collecting natural specimens as a fun hobby in the introduction.[152] It consists of seven chapters that all treat one type of organism or object you could collect from insects and shells to plants and skulls, and, of course, minerals. The chapter on minerals consists of 22 pages, which is small compared to the chapter on plants that contains 177 pages, but comparable to the lengths of the chapters on shells, eggs and skulls. In the chapter, Winkler discusses five types of minerals, where to get them and how to classify them. The chapter closes with a classifying system the amateur could adopt for his collection. Winkler thus encourages his readers to take up mineral collecting as a hobby on the one hand, but stresses the classificatory principles on which to organise collections on the

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[147] Winkler, *Handboek Voor Den Verzamelaar: Een Praktisch Boek, Leerende Het Aanleggen, in Orde Maken En Onderhouden van Alle Soorten van Verzamelingen*.
[148] J G de Bruijn, 'T.C. Winkler, een 19e eeuws popularisator van de geologie', *Grondboor & Hamer* 25, no. 5 (1971): 111–14.
[149] Donna C. Mehos, 'Science joined Cultural Life', in *Science and Culture for Members Only: The Amsterdam Zoo Artis in the Nineteenth Century* (Amsterdam: Amsterdam University Press, 2005), 91-124, https://doi.org/10.1515/9789048503810, 112.
[150] Winkler, *Handboek Voor Den Verzamelaar: Een Praktisch Boek, Leerende Het Aanleggen, in Orde Maken En Onderhouden van Alle Soorten van Verzamelingen*, 1
[151] W.W. Kolvoort, 'Een Levend Herbarium', *De Levende Natuur*, 1902, 226–28, 226.
[152] Winkler, *Handboek Voor Den Verzamelaar: Een Praktisch Boek, Leerende Het Aanleggen, in Orde Maken En Onderhouden van Alle Soorten van Verzamelingen*.

other. Herewith, Winkler can be seen as a transitional figure that propagates both a nature as order-regime and a nature as leisure-regime.

In his introduction, Winkler provides examples of minerals in popular culture such as Aladin's magic lamp made of silver, gold and gems and fairy tales from the mountainous areas about dwarfs that live in caves filled with lustrous gems.[153] Winkler writes that we can also experience this fairy tale wonder from studying minerals in their natural environment.[154] He divides the different types of rocks up in five groups, namely gems, ordinary rocks, ores, salts and flammable substances. For each of these types he also provides tips on where to find them. Some of these minerals could be found in the Dutch landscapes, such as granite, gneiss, basalt and porphyry. [155] Winkler suggests to go outdoors to look for these specimen yourself. He also advises his readers to look for rocks alongside new roads. Here one can find very unique specimens for Dutch nature that have been dug up during the construction work, or broke off from new imported material that the road was made of.

The fairy tale wonder of nature, Winkler argues, can also be experienced from studying minerals in a collection.[156] Since most minerals cannot not be found in Dutch nature, Winkler also gives his readers some tips on where else to find certain minerals. In case of gems, he advises readers to look for jewels that are no longer fashionable that might contain a gem. For the ordinary stones, Winkler suggests visiting a curb stone maker for limestone, a gravestone maker for lithographic stones and a stone mantel maker for marble. Often these craftsmen have left over pieces of rock lying around that you can take. Furthermore, Winkler suggests you can buy most salts at an apothecary and most flammable substances can be bought at a reasonable price such as coals for in your stove. Winkler's collecting advise was mainly focussed on enabling his readers to create a complete mineral collection in their own homes.

Besides the issue of availability of rocks in the Netherlands, Winkler also admits that it is not easy for a layperson to distinguish all minerals, especially compared to specimens of living nature.[157] He provides the reader with some practical tips so they will not be discouraged. For example, for the salts he advises his readers to smell and taste them carefully. One could also hold the salts into a flame to see if the salt melts or whether the flame changes its colour. When it comes to ores, he suggests making a stroke with it on a white porcelain plate to see its colour better. Lastly, Winkler gives a short explanation on how to use a blowpipe to research your rocks. On the basis of these simple research methods, Winkler claims the amateur should be able to come a long way in determining his or her minerals. If you want to improve your categorization, however, he suggests buying German handbooks

[153]Ibidem, 1-7
[154] Ibidem, 8-11
[155] Ibidem, 8-11
[156] Ibidem, 8-11
[157] Ibidem, 11-15

on the topic and asking the help of an expert. Since your mineralogical systematization can continuously change by doing the types of experiments he describes above, Winkler furthermore recommends storing minerals in drawers with cart board boxes. This way, you can change your specimens around continuously. Whilst emphasizing the enjoyment of the activity of creating your own collection, Winkler also stresses the importance of good classification practices.

The handbook is also interesting because of the clear differences it presents between collecting minerals and objects of living nature. In Winkler's last chapter on keeping live plants and animals in terraria, aquaria and insectaria, he pays very little attention to elements of non-living nature present in these miniature enclosures.[158] Even though these elements are present in the drawings that serve as examples, he does not mention them specifically. In figure 3, the example drawing of an island in a terrarium is given of which the animals and plants are mentioned but the rocks are not.[159] Meanwhile, Winkler is very specific on the types of plants and animals that can live together in one enclosure. He recommends specific species to live together that also live together in nature, outdoors. There is only one instance in which Winkler mentions the need for a rock in an enclosure, namely in the aquarium. He states:

Figure 3 - Rocks on island in terrarium

'If the size of the aquarium allows it, you should make a rock out of dripstone or other limestone. That rock group can represent a simple gate, or better still a vault standing on three pillars. Stones of all kinds can easily be combined with a little Portland cement into all kinds of shapes. … The rock is supported by placing stones around it from below, and everything is then made solid with cement.' [160]

Although Winkler recommends placing a rock in the middle of the aquarium, this rock should be polished in different ways and put together with cement. This way the rock is used as an ornament instead of being an integral part of the small ecological system created. Herein, we can see a sign of

[158] Ibidem, 1-42
[159] Ibidem, 25
[160] Ibidem, 4-5 'Als de grootte van het aquarium het enigszins toelaat, moet men een rots uit druipsteen of een ander kalkgesteente maken. Die rotsgroep kan een eenvoudige poort voorstellen, of nog beter een gewelf dat op drie pilaren staat. Steenen van allerlei soort kan men een weinig portlandcement gemakkelijk tot allerlei vormen vereenigen. … De rots steunt men door er van onderen steenen omheen te leggen, en alles wordt dan met cement stevig gemaakt.'

the new natural history approach that often excluded minerals from its studies. The new natural history mainly studied living organisms' interactions like in the later discipline of ecology.

The other nineteenth-century disciplinary development wherein mineralogy became a subdiscipline of geology, however, is not present in Winkler's work. Winkler focussed entirely on mineralogy and mineral-determination. The geological value of rocks is not mentioned. Herewith, Winkler can be said to have propagated both a nature as order- and a nature as leisure-regime. In later articles of *De Levende Natuur* and in Van der Lijn's *Boulder Book*, mineralogy is often subordinated to geology. Mineralogy was often seen as a mandatory step in the process of geological research by the authors. In the next section, I will discuss how the articles in *De Levende Natuur* expressed a nature as leisure-regime in popular mineralogy.

Heimans and Thijsse's Natuursport

The nature as leisure-regime is very closely related to the view of nature held by two natural history reformers around the turn of the twentieth century called Eli Heimans and Jacques P. Thijsse. Heimans and Thijsse promoted a view of nature they called 'natuursport' or 'nature sports'.[161] The activity of experiencing nature is central to natuursport. According to Fred de Ruiter, the philosophy of natuursport had originated from two professors at the university of Amsterdam, Johan Oudemans and Hugo de Vries.[162] These professors would take their students on trips in and around the city to study the surrounding landscapes. One of their students was Coenraad Kerbert. Kerbert became a teacher of botany and zoology in 1878 at the training school for teachers in Amsterdam. Here, Kerbert also taught Heimans and Thijsse. On top of that, Kerbert became the head conservator of the aquarium of *Artis* and in 1890 he succeeded Gerard Westerman as the director of the zoo.

Heimans and Thijsse , however, became the best-known representatives and propagators of natuursport.[163] The Amsterdam school teachers wrote a variety of articles and books wherein they would encourage readers to go explore nature for themselves. The landscapes Heimans and Thijsse discussed were always national landscapes, easily accessible to the Dutch audience. They were not the first authors to popularise nature by discussing the ordinary local nature. Frederik Willem van Eeden and Tiberius Cornelis Winkler had done so before them as well. The biggest difference is that Heimans and Thijsse's work is free of any physicotheology and moralistic messages. They did not teach their

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[161] Klaas van Berkel, 'Heimans En Thijsse En Het Boek Der Natuur', in *Citaten Uit Het Boek Der Natuur: Opstellen over Nederlandse Wetenschapsgeschiedenis* (Amsterdam: B. Bakker, 1998), 265–96, 266.
[162] Fred de Ruiter, *Natuurschatten. Natuurhistorische collecties in Nederlandse musea.* (Utrecht: Stichting Matrijs, 2020) 107.
[163] See e.g. Ibidem, 107 ; Berkel, 'Heimans En Thijsse En Het Boek Der Natuur', 275-284 ; Bert Theunissen, 'Natuursport en Levensgeluk: Hugo de Vries, Eli Heimans en Jac. P. Thijsse', *Gewina* 16 (1993): 287–208 ; L. Dresen, 'Op weg naar een nationaal landschap: botanische wandelingen in het "Album der Natuur" (1861-1909)', *BMGN - Low Countries Historical Review* 121, no. 4 (1 January 2006): 650, https://doi.org/10.18352/bmgn-lchr.6524.

audience about Creation. Instead, Heimans and Thijsse, wanted to merely excite their readers about the nature that could be found in Amsterdam but also outside of city. They used less pompous language and did not provide philosophical reflections. Their tone was informal but informational nevertheless. On top of that, they pointed their readers more to the behaviours and interactions of organisms than to their looks. Klaas van Berkel argues that Heimans and Thijsse launched a 'biological reveil' in the Netherlands this way.[164]

In 1896, together with J. Jaspers, Heimans and Thijsse worked on spreading their natuursport-philosohy by founding *De Levende Natuur.* The magazine reached a thousand subscribers in three months.[165] This was a high number for that time and signalled the demand for this type of literature. However, the number of subscribers never rose above 1700. *Artis* also received the magazine and it was often requested from the library.[166] *De Levende Natuur* translates to *The Living Nature.* This title suggests that the magazine only contained articles on living nature. However, from 1909 onwards the magazine also published articles on non-living nature. Eli Heimans himself was the first author in 1909 to publish an article on popular geology in which he also discussed mineralogy.[167] By now, mineralogy had become a subdiscipline of geology and the disciplines were often mixed in articles therefore. Twenty-five articles on mineralogy followed in the period between 1909 and 1938. There are also small traces visible of popular mineralogical undertakings in other sections than the main pieces, even before 1909.

In 1897, the editors launched a 'Vragen en korte mededeelingen' (Questions and short notices) section where readers could publish their questions and experiences.[168] According to the founders of the magazine, findings should be widely shared with other active lovers of nature. Their magazine became an excellent platform for this. In 1909, the interactive section contained an announcement by Mr. J.C. Ceton from Amsterdam. Ceton invited readers to become a member of the 'Deutscher Lehrerverein für Naturkunde' (The German Teachers' Association for Natural History).[169] This association stimulated natural history research among amateurs by hosting expeditions and publishing a small magazine with articles on botany, zoology and mineralogy. According to Ceton, more and more Dutch people were becoming a member of this German association. This might suggest that the practical natural history and mineralogy was better organised in Germany.

De Levende Natuur and its contributors are often considered having laid the foundations for

[164] Berkel, 'Heimans En Thijsse En Het Boek Der Natuur', 275-276
[165] Isa Schimmel, 'De Levende Natuur Eeuwig', *De Levende Natuur* 97, no. 2 (1996): 92–97, 92
[166] Natura Artis Magistra, 'Weekrapporten van de Bibliotheek N.B. Aangevende de Ingekomen Boeken En Tijdschriften, de Uitgeleende - En Terugontvangen Boeken En de Aantallen Bezoekers in de Leeskamer 1890-1922', 1901, 1930, 395 Het Archief van het Koninklijk Zoölogisch Genootschap Natura Artis Magistra.
[167] Eli Heimans, 'Gesteenten', *De Levende Natuur* 14, no. 1 (1909): 6–9.
[168] Schimmel, 'DLN eeuwig', 92-93
[169] J.C. Ceton, 'Deutsche Lehrerverein Für Naturkunde', *De Levende Natuur* 5, no. 2 (1900): 47.

other such networks of collectors in the Netherlands.[170] Nederlansche Natuurhistorische Vereeniging (The Dutch Natural History Association) is such a network that was established in 1901. This association published a small magazine that became available as an appendix to *De Levende Natuur.* In these appendices more clues can be found that Dutch amateurs were already occupied with collecting and studying minerals before 1909. In an edition from 1905 one can find a report on the popular geological course given by dr. H.G. Jonker form the Geological- Mineralogical Institute in Groningen for example.[171] In that same appendix it is written that the Natuurhistorische Vereeniging in Amsterdam had received several books and collections on mineralogy.[172] In the next issue, however, one of these books is already up for sale. Moreover, in the appendix of the Natuurhistorische Vereeniging and the Question and notices sections of *De Levende Natuur*, there are solely minerals for sale and never sought-after.[173] This might suggest that readers were primarily keen on getting rid of their mineralogical objects and books. It concerns only four ads in total, however. Therefore it is questionable whether people were indeed more eager to lose their minerals and books on mineralogy than to gain them. These sections do imply that there was amateur-activity going on in the realm of mineral collecting, suggesting the presence of the nature as leisure-regime.

The presence of the nature as leisure-regime for mineralogy in *De Levende Natuur* becomes more clearly visible in the main articles of the magazine. One of the biggest challenges that these popularisers of mineralogy in the Netherlands had to overcome in promoting the study of mineralogy as a pursuable hobby, was the scarce availability of minerals in the Dutch soils. If the Dutch audience had no way of encountering minerals in their natural surroundings, there was no way of interacting with the material. In his article form 1909, Heimans stated that the main goal of the first series of articles on non-living nature was to combat this idea that the Netherlands does not have any interesting material to study.[174] Just the other day Heimans had encountered a lot of interesting material at the Zuiderzeedijk at a half-hour bike ride from his home in Amsterdam. He had found beautiful basalt with a lot of clear augite crystals. Heimans provided drawings from the pieces of basalt under a microscope and uses these to explain that rocks are composed of different crystallized minerals.

The articles on mineralogy in *De Levende Natuur* that followed Heimans' illustrated the

[170] Schimmel, 'DLN eeuwig', 92
[171] Redactie, 'Geologische Cursus van Dr. H.G. Jonker', *De Levende Natuur*, Nederlansche Natuurhistorische Vereeniging, 10 (1905): 35.
[172] J. Jaspers, 'Inlichtingendienst Ruilverkeer - Ingekomen & Aangeboden', *De Levende Natuur*, Nederlansche Natuurhistorische Vereeniging, 10 (1905): 39, 46, 54, 61 ; onbekend, 'Te Koop Aangeboden', *De Levende Natuur*, Nederlansche Natuurhistorische Vereeniging, 8 (1903): 46.
[173] A.G.W.H. Beeger and P. Van Eijk, 'Korte Vragen En Mededeelingen: Ruilaanbod', *De Levende Natuur* 20 (1916): 180 & 440.
[174] Heimans, 'Gesteenten', 7.

presence of interesting minerals and rocks in the Dutch landscape as well. They transported the reader into these different landscapes and encouraged them to visit the regions themselves. Klaas van Berkel and Leen Dresen have shown that such a landscape description was a very often used format for popularisers in natural history.[175] In these descriptions one could read about the different animals and plants present in the landscape. Yet, authors rarely paid attention to the non-living nature present in that same landscape. Similarly, I have rarely encountered any references to the presence of living nature in the geological or mineralogical landscape descriptions.

One such example of a landscape description that only describes non-living nature is J.B. Bernink's article on his first geological tour with his pupils.[176] Bernink was a school teacher in Denekamp and the founder of a small natural history museum called Natura Docet. Bernink's interest was sparked by Heimans' article just two years earlier.[177] Bernink had bought a few German works on the subject and started collecting specimens for his museum straight away. Bernink tells the reader how he had read up on petrology, mineralogy, geology and palaeontology in preparation of this specific school trip. [178] During the trip itself, he divided up the kids in different groups and gave them the assignment to collect different kinds of rocks and minerals. He handed out old lucifer- and cigar boxes for the kids to save their specimen in. Whilst collecting, Bernink explains, he would sometimes break the rocks to see what was inside. Meanwhile, he also provided his students with information on what certain rocks could tell you about the geological history of the landscape and what the materials could be used for in daily life. Many children had found quartz in one form or another, for example. Bernink explained these could be grained to sand of which glass was made. Bernink and his pupils were very pleased with the results of their collecting and even saved some specimen for the mineralogical cabinet of Natura Docet. He emphasized how much fun the kids had and encourages his readers to go study and look for rocks themselves too.

Other authors also encouraged their readers to go out into nature. Whereas Bernink tells his readers he went out into 'the surroundings' of Denekamp and Lutte, some authors gave much more detailed instructions for their readers on where to go explore nature. For example, D.J. van der Ven in his 'Neerlands Thuringen'.[179] In the introduction of the article, Van der Ven claims that the nature between the towns of Velp and Steeg is mostly appreciated for its ornithological and botanical variety. Van der Ven, however, wishes to highlight the geological particularities of this region. Van der Ven warns his readers that he will not discuss geology in the way that the old grey natural history teacher

[175] Berkel, 'Heimans En Thijsse En Het Boek Der Natuur', 278 ; Dresen, Nationaal Landschap 651.
[176] J.B. Bernink, 'Onze Eerste Geologische Tocht Naar Lutte(Bij Denekamp)', *De Levende Natuur* 16 (1912): 323–327.
[177] J. B. Bernink, 'Hoe ik amateur geoloog werd', *De Levende Natuur*, 1916, 373–74.
[178] Bernink, 'Onze Eerste Geologische Tocht', 323-327.
[179] D.J. Van der Ven, 'Neerlands Thüringen', *De Levende Natuur* 15, no. 7 (1910): 109-112, 125–31.

would. He will not 'torment' the readers with crystallography and nomenclature.[180] Instead, he specifically states that he will take the new lively natural history approach of Heimans and Thijsse.

In doing so, Van der Ven provides two maps of the area and suggests a route along several geological phenomena.[181] One of the maps can be seen in figure 4. Van der Ven had drawn the map himself. He instructs his reader to go to the train station of Steeg to start the tour. From here you should turn left on the main road until one can see a smaller road after 5 minutes. Before leaving, however, Van der Ven advises to take a compass, map, water flask and mountain stick. The first geological phenomenon one will encounter are orange-coloured farmlands. Van der Ven explains these are made of a type of earth called loess. Van der Ven goes on to explain how this earth was formed here by geological, erosive powers.

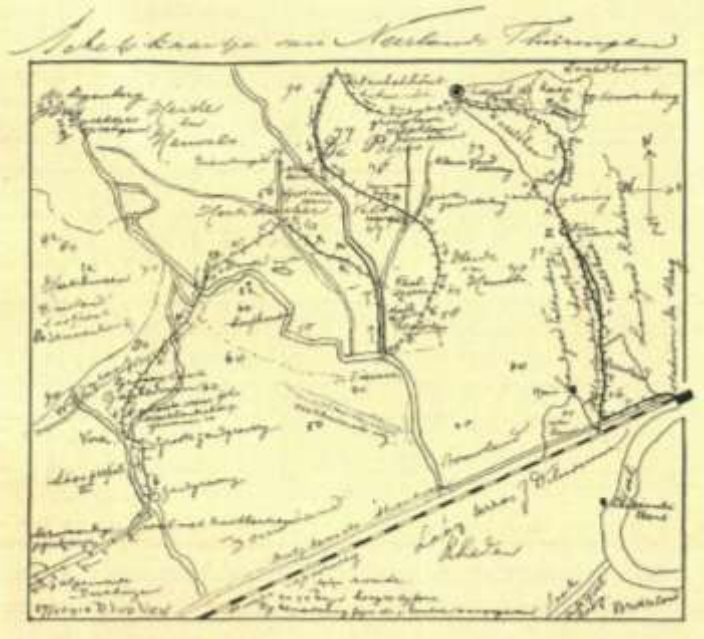

Figure 4 - Drawn map of "Neerlands Thuringen"

Dr. P. Tesch takes a similar approach in his article in which he invites the reader on a walk in the landscapes around Venlo.[182] Tesch gives a very accurate route description and added a map that indicated where the different landmarks were located (see figure 5). This route also goes from one train station to another.

[180] Ibidem, 112 'Wanneer gij dit alles leest, zullen enkelen uwer het beeld voor hun geest halen van een ouden grijzen leeraar in de Nat. Historie U ziet hem aandragen allerlei octaëders, hexaëders, dodecaëders en nog vele andere anders meer, en ge zult u herinneren uw wanhopige pogingen om al de stelsels uit elkaar te houden, ten slotte verwardet gij ze toch, en de animo voor dat vak was, zooals licht te begrijpen is, zeer gering.'
[181] Ibidem, 126-127.
[182] P. Tesch, 'Een Geologische Wandeling', *De Levende Natuur* 15, no. 14 (1910): 265–70.

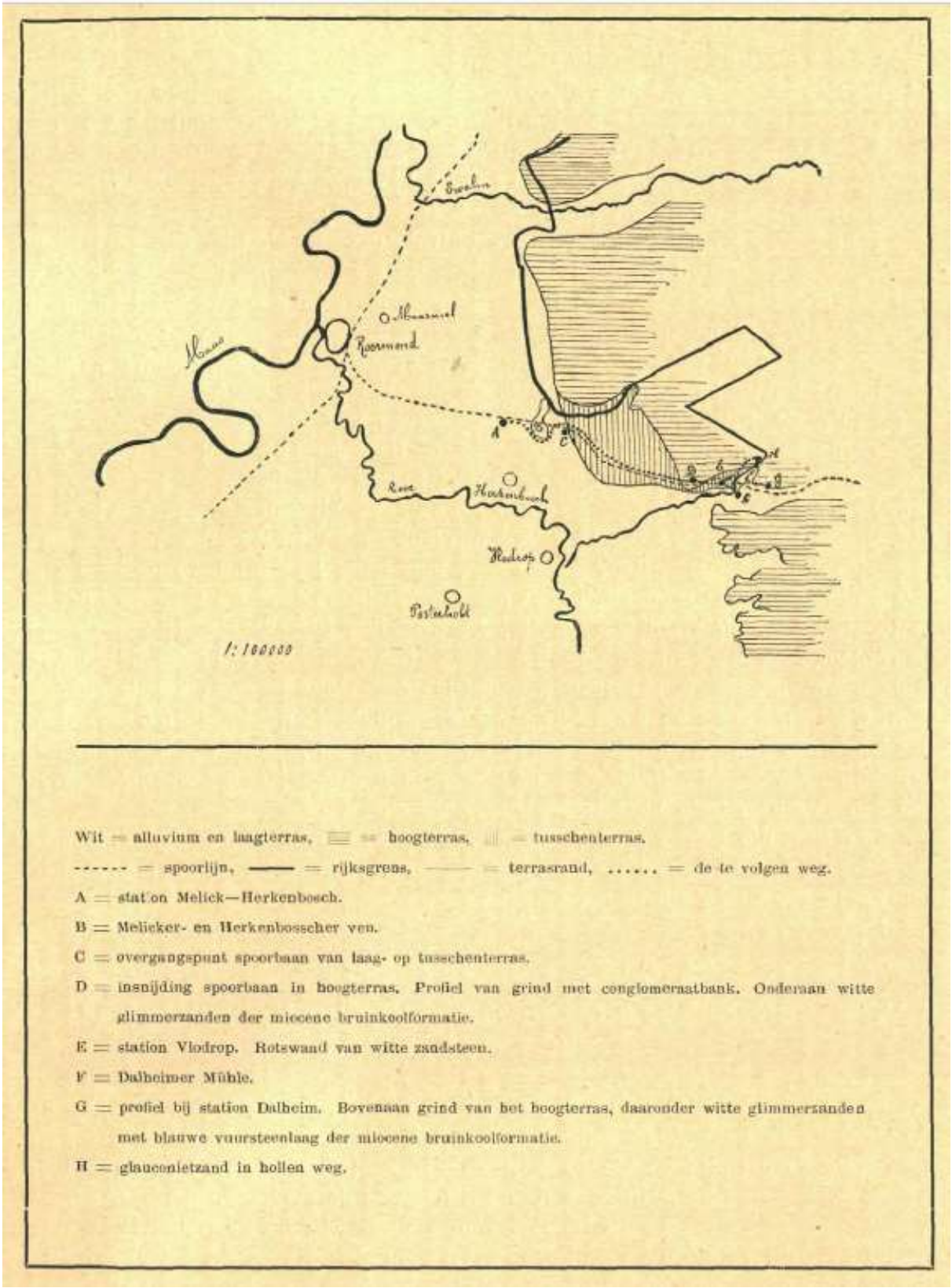

Figure 5 - Map of surroundings Venlo

In between the route directions, Tesch highlights all sorts of different mineralogical and geological phenomena. Past the valley of Roode Beek, for example, Tesch highlights a peculiar type of green-

yellowish sand mixed with dark green and black grains.[183] Tesch explains these grains are made up of a mineral called glauconite. The presence of this sand taught us that the landscape was formed during the tertiary epoch in the earth's history when this sand was deposited there. The works of Tesch, Heimans, Bernink and Van der Ven were all meant to show the reader that the study of geology was accessible in the Netherlands. Heimans and Bernink did so by describing their own trips through nature. Tesch and Van der Ven gave concrete instructions to their readers to see the most interesting geological phenomena for themselves. The way the works treat geology and mineralogy as an enjoyable activity shows a strong nature as leisure-regime.

Eli Heimans passed away suddenly in the summer of 1914 on a geological expedition in Germany. Following his death, the Heimans Foundation was founded. [184] An initiative was taken to realize Heimans' dream of a creating a botanical-geological museum on *Artis'* grounds. Sadly, this was never realized due to the outbreak of First World War and the years of financial crisis that followed. In 1926, the foundation did succeed in establishing a diorama in the zoo's Aquarium building called the Heimansdiorama. This diorama represents the Dutch dune landscapes. Jacques P. Thijsse passed away in the hunger winter in the Second World War. In honour of him, the Dr. Jacques P. Thijsse Fund was founded. In 1993 the foundations merged and their office is still located on the *Artis* grounds.

What stands out in the articles in *De Levende Natuur* is that most authors saw mineralogy merely as a necessary means to recognize and classify rocks, however.[185] Most authors addressed only the necessary basics of mineralogy to understand the actual story they want to tell, namely the local or national history of the landscapes addressed. It is illustrative of the ontological change of minerals that I discussed in the introduction. Herein, rocks were mainly appreciated for their historical or evolutionary value from the second half of the nineteenth century forward. Nevertheless, the act of collecting rocks and beholding their mineralogical make-up was seen as an enjoyable activity in Heimans and Thijsse's natuursport. This geological natuursport was quickly taken up and incredibly well popularised by Pieter van der Lijn, whose work I will discuss in the next paragraph.

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[183] Ibidem, 270

[184] 'Geschiedenis van de Stichting', *Heimans en Thijsse Stichting* (blog), accessed 18 January 2021, http://www.heimansenthijssestichting.nl/over-ons/geschiedenis-van-de-stichting/ ; onbekend, 'Zoölogisch Museum en Heimans Diorama', *Het Vaderland : staat- en letterkundig nieuwsblad*, 21 June 1926, https://www.delpher.nl/nl/kranten/view?coll=ddd&identifier=ddd:010010325:mpeg21:a0128.

[185] See also e.g. J.A.J.M. Van Waterschoot van der Gracht, 'Schetsen Uit Een Zeer Ver Verleden', *De Levende Natuur* 15, no. 3 (1910): 45–49 ; P. van der Lijn, 'Zeldzame Zwerfsteenen', *De Levende Natuur* 22, no. 4 (1917): 135–41 ; K. Van der Kley, 'Hoe Moet Men Steenen Verzamelen?', *De Levende Natuur* 39, no. 4 (1934): 125–29 ; J. B. Bernink, 'De Studie Der Aardkunde, Voorheen En Thans', *De Levende Natuur* 41, no. 4 (1936): 105–13.

Van der Lijn's *Boulder book* (1923)

Pieter van der Lijn published his first article in *De Levende Natuur* in 1917.[186] His article was called 'Zeldzame Zwerfstenen' or 'Rare Erratic Boulders'. These are stones or boulders that are lying around in and on the Dutch soils. These rocks contain interesting information of mineralogy and geology. After his first successful article, Van der Lijn launched a whole series on different types of erratic stones for readers to study themselves. In 1923, he summarized all this knowledge in *Het Keienboek* or *The Boulder book.*[187] This book remained in print until 1986. From this we learn that Van der Lijn's method of popularising non-living nature caught on. Although Van der Lijn, like many of his contemporaries, was mostly keen on teaching his readers about historical geology, he also often discussed mineralogical knowledge. He saw mineralogy as the basis for recognizing rocks before being able to study them historically. His works contain a strong nature as leisure-regime.

In his first article on erratic boulders, Van der Lijn suggests that studying rocks is much more interesting than studying plants because of the immense individual variety between rocks.[188] Like everyday dandelions and daisies are often not taken up in botanical collections, everyday pieces of quartz and sandstone are often not taken up in geological cabinets. Van der Lijn argued that these everyday rocks are very interesting and encouraged his readers to incorporate them their own natural collections. Erratic boulders all contain unique attributes that can teach you about their formation and history. For example, in two articles Van der Lijn discussed so-called wind rocks.[189] These rocks display particular shapes due to the wind they have been exposed to for long periods of time. The shape of these rock can tell you from which positions it has been subjected to heavy winds and therewith where the rock possibly originated from. In these articles, however, the mineralogical makeup of the rocks is not discussed. Van der Lijn's emphasis on the origin of rocks and lack of discussion on its mineralogical composition testifies of the changed ontological status of rocks. Rocks were no longer interesting in themselves but seen as carriers of information about the earth's past.

Examples in which the mineralogical and crystal structures do play a key role, are the articles about agates and rapakivis.[190] In the first part of the article on agates, Van der Lijn present his reader with a mineralogical definition of agates.[191] Van der Lijn defines agates as: 'concentric striped or

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[186] P. van der Lijn, 'Zeldzame Zwerfsteenen', 135–41.
[187] P. van der Lijn, *Het Keienboek : Inleiding Bij de Studie Onzer Zwerfsteenen* (Zutphen : Thieme, 1923).
[188] Lijn, 'Zeldzame Zwerfsteenen', 135
[189] P. van der Lijn, 'Windkeien', *De Levende Natuur* 22, no. 10 (1918): 370–78, 374 ; P. Van der Lijn, 'Over Windkeien', *De Levende Natuur* 40, no. 8 (1935): 139–45 & 170–77, 176.
[190] P. Van der Lijn, 'Achaten Ook Als Zwerfsteenen', *De Levende Natuur* 32, no. 9–10 (1928): 285–91 & 319–23 ; P. Van der Lijn, 'Onze Rapakivi's', *De Levende Natuur* 38, no. 3 (1933): 77–84.
[191] Van der Lijn, 'Achaten Ook Als Zwerfsteenen', 285-91. '… het zijn de doorgaans concentrisch gestreepte of gevlamde mengsels van verscheidenheden van kiezelzuur of SiO2, afgezet in blaasvormige ruimten van vulkanische gesteenten, in 't bijzonder van melafier, het zwarte uitvloeiingsgesteente, dat veel op bazalt lijkt.'

flamed mixtures of varieties of silica or SiO2 deposited in bubble-shaped spaces of volcanic rocks, in particular of melafir, the black effluent rock, which looks a lot like basalt.' Van der Lijn even gives a chemical explanation for these stripes and how chemists can synthesize these themselves. He also recommends prof. Kuyt's book on chemistry to those who were interested in this process. It is not until the second part of the article later in the magazine that Van der Lijn addresses how this process might have taken place in the earth and what the historical value of these rocks are. Clearly, Van der Lijn wanted his readers to get familiar with the mineralogical composition and processes before studying the geological relevance of agates.

In his article on rapakivis, Van der Lijn explains that these rocks are best known for their unique round mineral shapes of quartz and feldspar.[192] These round crystal shapes are uncommon in the mineral world. Van der Lijn refers to the many technical mineralogical terms for these crystal structures but explains them in more simple language. The middle of rapkivis, for example, consists of an 'ovoid' or 'egg-shaped' mineral, Van der Lijn explains. Again, it is not until the second part of the chapter that Van der Lijn goes into the geological relevance of the rock. Herein, Van der Lijn explains that it was not yet known how these rocks could have formed. They were a geological mystery.

Van der Lijn often provided his readers with tips on collecting erratic stones in passing. In the article on agates, for example, he tells his readers about a shop in Haarlem where they could buy raw agates for their collection.[193] Another interesting article that contains some collecting tips is his article on minerals that could be found along a new road near Amersfoort.[194] Van der Lijn explains that for the construction of roads a lot of basalt was imported from Belgium. This basalt often contained very interesting mineralogical specimens. Van der Lijn presents several experiments for his readers to perform on these basalt stones. By smashing and studying the cleavage the white veins in basalt, one can determine whether its common calcite or more precious dolomite. Another way of determining the veins was by sprinkling them with acid and see if bubbles appear. Van der Lijn explains how many people tend to mix these up because they have very similar characteristics such as their colour, crystal structure and shine. With these easily accessible rocks and hands-on experiments, this article forms a perfect example of the nature as leisure-regime.

In 1923, Van der Lijn put together all the knowledge on erratic boulders from his articles in *De Levende Natuur* in his *Boulder book.*[195] In this book the nature as leisure-regime is even stronger than

[192] Van der Lijn, 'Onze Rapakivi's', 77-78.
[193] Van der Lijn, 'Achaten Ook Als Zwerfsteenen', 286. Echte achaten en andere siersteenen zijn in enkele betrouwbare winkels wel te verkrijgen, o.a. bij Peddemors in Haarlem, waar schr. aantrof: gehande roode achaat, bruingestreepte witte onyx, violette amethyst, parelmoerachtige opalen, groene plasma, rood gevlekte heliotroop, en nog wel andere.'
[194] P. van der Lijn, 'Geologie En Mineralogie Langs de Nieuwe Wegen', *De Levende Natuur* 34, no. 6 (1929): 200–206, 235–38.
[195] Lijn, *Het Keienboek*.

in his articles. In his introduction, Van der Lijn literally states that 'After all, nature is a source of pleasure, a means of regaining new strength in the struggle for life.'[196] With this book, he managed to make the study of mineralogy and geology accessible to a broad audience. The book was targeted at an amateur audience who did not own a microscope, but were interested in the subject purely for their enjoyment. Since the microscope had become essential in modern mineralogy for the determination of rocks, Van der Lijn's goal with his book was to prevent people from collecting specimens they could not determine. He therefore encouraged his audience to go looking for erratic boulders instead. Van der Lijn admits that university professors frowned upon this study of geology without a microscope. He explains that the microscopic study of geology, however, 'is unattainable and also unintentional for amateurs: they do not wish to be taught but still want to know; they make some effort, some study, but not lengthy.'[197]

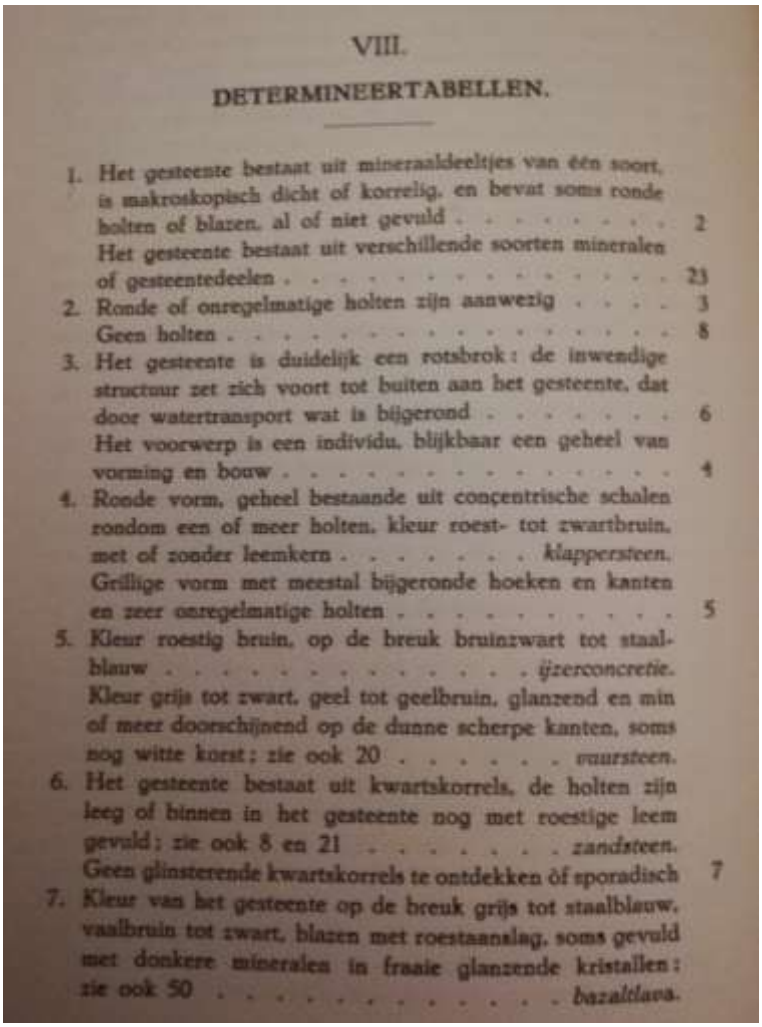
The Boulder book is a guide for amateurs to get started with their geological studies.[198] Van der Lijn shows that these had already been widespread in Germany for decades. He drew on these as examples. As I have shown in the introduction, Van der Lijn discusses the materials one should take if you are going out to collect rocks. Among these materials are wrapping materials, a hammer or pickaxe and pen and paper. Furthermore, you should own a soft brush. With it you can clean the rocks carefully at home. Van der Lijn suggests determining the rocks at night in the salon to keep one's mother or spouse company.

In order to determine the rocks, Van der Lijn claims, one should have a basic understanding of mineralogy.[199] Determining a rock always precedes studying its history. The second chapter therefore is entirely dedicated to the study of mineralogy that can be performed with simple tools and no prior knowledge of chemistry. In total, Van der Lijn addresses eight mineral characteristics for determining rocks, namely colour, lustre, cleavage, hardness, density, chemical components and crystal structures. These characteristics are ordered from easy to study to hard to study. Van der Lijn describes several experiments amateurs can easily perform such as scratching stones with other stones to determine which one is the hardest. To determine the density of rocks, he suggests an experiment with weights and water, to measure the volume of the rocks compared to their absolute weight. The crystal structures are the hardest characteristics to study, according to Van der Lijn, because they are so varied. He does provide a few simple structures one could recognize with a magnifying glass. This is in strong contrast with the authors of the last chapter on the nature as order-regime who argued crystal

[196] Ibidem, 1-2. 'Immers, is de natuur voor een bron van genot, middel om in den levensstrijd weer nieuwe krachten op te doen.'
[197] Ibidem, 1. 'Voor amateurs is dat onbereikbaar en ook ongewild: zij wenschen niet geleerd te worden maar willen toch weten; zij getroosten zich daarvoor eenige inspanning, eenige studie, maar geen langdurige.'
[198] Ibidem, 1-4
[199] Ibidem, 6-16

structures were the easiest characteristic to study.

After the second chapter, the content of Van der Lijn's book gets increasingly geological, explaining the history of certain landscapes based on different types of rocks that can be found there.[200] Van der Lijn continuously takes the reader by the hand to guide him through his geological research. To aid the reader, pages 57 until 79 are filled with pictures to illustrate some of the rocks that Van der Lijn discusses to aid the reader. Chapter eight provides an identification table for the different rocks, that is constructed like step-by-step plan.[201] It asks questions that can be answered with yes or no. On the basis of the answer you are referred to the next question or most likely outcome. The table can be seen in figure 6.



VIII.

DETERMINEERTABELLEN.

1. Het gesteente bestaat uit mineraaldeeltjes van één soort, is makroskopisch dicht of korrelig, en bevat soms ronde holten of blazen, al of niet gevuld 2
   Het gesteente bestaat uit verschillende soorten mineralen of gesteentedeelen 23
2. Ronde of onregelmatige holten zijn aanwezig 3
   Geen holten 8
3. Het gesteente is duidelijk een rotsbrok: de inwendige structuur zet zich voort tot buiten aan het gesteente, dat door watertransport wat is bijgerond 6
   Het voorwerp is een individu, blijkbaar een geheel van vorming en bouw 4
4. Ronde vorm, geheel bestaande uit concentrische schalen rondom een of meer holten, kleur roest- tot zwartbruin, met of zonder leemkern . . . . . *klappersteen.*
   Grillige vorm met meestal bijgeronde hoeken en kanten en zeer onregelmatige holten 5
5. Kleur roestig bruin, op de breuk bruinzwart tot staalblauw . . . . . *ijzerconcretie.*
   Kleur grijs tot zwart, geel tot geelbruin, glanzend en min of meer doorschijnend op de dunne scherpe kanten, soms nog witte korst; zie ook 20 . . . . . *vuursteen.*
6. Het gesteente bestaat uit kwartskorrels, de holten zijn leeg of binnen in het gesteente nog met roestige leem gevuld; zie ook 8 en 21 . . . . . *zandsteen.*
   Geen glinsterende kwartskorrels te ontdekken óf sporadisch 7
7. Kleur van het gesteente op de breuk grijs tot staalblauw, vaalbruin tot zwart, blazen met roestaanslag, soms gevuld met donkere mineralen in fraaie glanzende kristallen: zie ook 50 . . . . . *bazaltlava.*

Figure 6 - Van der Lijn's tabel for determining rocks

Chapters nine and ten provide lists of libraries and museums in the different provinces that contain interesting geological collections for amateurs to extend their study.[202] Van der Lijn even invites his

[200] Ibidem, 16-230
[201] Ibidem, 230-245
[202] Ibidem, 246-250

readers to send him a letter whenever they get stuck in their process, under the condition that they would add a postal stamp for Van der Lijn to answer them.

All in all, Van der Lijn's approach of popularising mineralogy with erratic boulders was a very accessible form of popular mineralogy. Like the new natural history and Heimans and Thijsse's natuursport, Van der Lijn focussed on local nature. The erratic boulders were widely available to an amateur public in different Dutch landscapes. On top of that, Van der Lijn succeeded in constructing a way of determining rocks with a mineralogical scheme that did not require any laboratory materials. Despite the fact that his main goal was to teach people about the history of the landscapes they collected material from, Van der Lijn still argued that some mineralogical knowledge should proceed this.

Conclusion

From this chapter we learn that towards the end of the nineteenth century, the nature as leisure-regime slowly takes the upper hand in popular mineralogy. In this regime, a view of nature as an enjoyable activity dominates. Winkler's *Handbook for the collector* can be seen as a transitional product expressing both the nature as order-regime and the nature as leisure-regime. The two Amsterdam teachers Eli Heimans and Jacques P. Thijsse and their idea of natuursport have been more influential in this shift between regimes. Although they mainly focussed on the popularisation of living nature in the Dutch landscape, from 1909 onwards they increasingly published on non-living nature in their magazine *De Levende Natuur* too. Herein, rock collecting and seeing geological phenoma in nature was portrayed as a fun hobby. Van der Lijn was also a follower of the natuursport philosophy. He used erratic stones as a local and accessible form of non-living nature to popularise mineralogy.

The authors from the natuursport movement, saw mineralogy as a mandatory step in their main goal of explaining geological research and telling a local or national history of the Dutch soils. They did not appreciate minerals in themselves but as sources of the past. Herein, the change in the ontological status of minerals becomes visible. Mineralogy had become a subdiscipline of geology. In Winkler's work we have observed the shifting of disciplinary boundaries in natural history that increasingly focussed on interacting organisms and therewith excluded non-living nature. In constructing terraria and aquaria, rocks were not discussed as being a part of the miniature ecological systems. Instead, the only rock discussed was seen as a building material for an aquarium ornament. The view of rocks as a building material, is part of the regime of nature that will be discussed next.

NATURE AS RESOURCE

'Gentle nature has opened up her treasuries for man. He only needs to make proper use of his physical strengths and mental powers, and she abundantly supplies not only his absolute necessities of life, but she also offers him countless objects, which serve to make life more pleasant and to make it easier to fulfil his destiny here on earth, as moral and reasonable being.'[203]

With this statement, Pieter Harting introduced his article on minerals in 1853 in the *Album der Natuur*.[204] Harting portrays nature as a female being that shares her mineral possessions with humankind for them to be able to live comfortably on this earth. The main body of Harting's article is an illustration of the daily uses of several minerals in society. The article is a perfect example of the last regime of nature I found in popular mineralogy between 1838 and 1938: the nature as resource-regime.

The nature as resource-regime is defined by Elizabeth Emma Ferry as 'nature conceived of as potential 'input' for production.'[205] Ferry shows that this regime of nature has a long tradition in European economic thinking such as in works by Locke, Smith, Marx and Ricardo. In these works, nature is thought to exist for humans to use to their convenience and that nature gains more value with the interference of human labour. The regime of nature is not bound to a certain time period such as the nature as order- and nature as leisure-regime. Instead, the nature as resource-regime can be recognized in almost all the sources that I have studied. The regime therefore appears to be near universal in all the popular activities concerning mineralogy with *Artis* as the socio-scientific hub. This chapter discusses the sources of popular mineralogy starting with those in which a moderate presence of the regime is found, to those with a stronger presence of the regime. While doing so, I will also discuss how the regimes of nature coexisted and influenced each other.

The first section discusses the sources wherein the nature as resource-idea is only sporadically mentioned in passing. This is mainly the case in articles in *De Levende Natuur* and Van der Lijn's *Keienboek* (1923) that propagate a strong nature as leisure-regime. From these sources we learn that the Dutch public was presumably more familiar with cultural objects made of minerals than the raw

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[203] Pieter Harting, 'De Delfstoffen, Eene Schets', *Album Der Natuur*, 1853, 13–29, 13. 'De milde natuur heeft hare schatkameren voor den mensch open gesteld. Hij behoeft slechts van de hem verleende ligchamelijke krachten en verstandelijke vermogens een gepast gebruik te maken, en rijkelijk voorziet zij niet alleen in zijne volstrekte levensbehoeften, maar bovendien biedt zij hem tallooze voorwerpen aan, die strekken tot veraangenaming van het leven, en om hem beter te doen beantwoorden aan zijne bestemming hier op aarde, als zedelijk en redelijk wezen.'

[204] Pieter Harting, 'De Delfstoffen, Eene Schets', *Album Der Natuur*, 1853, 13–29.

[205] Elizabeth Emma Ferry, '"Ziegfeld Girls Coming Down A Runway": Exhibiting Minerals at the Smithsonian', *Journal of Material Culture* 15, no. 1 (March 2010): 30–63, https://doi.org/10.1177/1359183510355224, 36.

material itself. The second section focusses on the most common format of mineralogy in written popular culture that I found. I termed this format the Mineral 101. In the Mineral 101-format, authors discussed one type of mineral in all its aspects. Authors would usually discuss its chemical composition and other physical attributes, but also where the raw material was mined and to what usages it could serve. Especially the *Album der Natuur* is rich in Mineral 101 articles, but five out of the six books that I have studied display a similar lay out.[206]

In the third section, I will discuss popular activities concerning three re-occurring popular minerals, namely gold, diamonds and so-called 'black gold' or coal.[207] From the 1880s onwards, the *Album der Natuur* hosted a series of articles on new diamond and gold mines that have been discovered in former Dutch colonies or settlements.[208] During the 1890s, the professor of geology at the University of Amsterdam gave multiple public lectures on diamonds and gold in *Artis*.[209] It was the looks and preciousness of these materials that popularisers used to appeal to their audience. Besides these costly minerals, coal was also a common subject of the articles in the *Album der Natuur*.[210] The new industrial society ran on coals and therewith it became a relatable, popular subject. Lastly, this chapter will address three exhibitions near or in *Artis* wherein minerals were exhibited as raw materials. *Artis* might have exhibited its minerals in a similar matter in their Ethnographic Museum.

Nature as resource in passing

The nature as resource-regime is near universal in the popularisation of mineralogy between 1838 and 1938. The extent to which this regime is present differs between sources that I have studied. I came across the least references of nature being seen as a resource in the articles in *De Levende Natuur* and Van der Lijn's *Keienboek* (1923). In the previous chapter, we have already witnessed some examples wherein authors of these works discuss certain minerals as the raw material for other applications.[211] For example, we have seen that Bernink taught his pupils about quartz sand being one of the main substances for making glass.[212] Bernink and his pupils had collected a lot of rocks on their trip, but this is the only instance in Bernink's report of the trip wherein he discusses a mineral as being a resource

[206] See e.g. A.W. Stellwagen, 'De Porcelein-Steen in China', *Album Der Natuur*, 1872, 157 ; P Harting, 'Het Asbest', *Album Der Natuur*, 1876, 289–90 ; G. Doijer van Cleeff, 'Oude Voorwerpen van Antimoon', *Album Der Natuur*, 1893, 287–88.
[207] Coal was termed 'black gold' in A.J.C. Snijders, 'De Vorming Der Steenkool', *Album Der Natuur*, 1885, 16–33, 16.
[208] See e.g. S.H. Junius, 'Iets over Diamanten - Kimberly', *Album Der Natuur* 56 (1907): 363–73.
[209] See e.g. 'Stadsnieuws.', *Het Nieuws van Den Dag : Kleine Courant*, 11 March 1893, https://resolver.kb.nl/resolve?urn=ddd:010091809.
[210] See e.g. Pieter Harting, 'De Engelsche Kolenmijnen', *Album Der Natuur*, 1862, 193–206.
[210] See e.g. 'Stadsnieuws.', *Het Nieuws van Den Dag : Kleine Courant*, 11 March 1893,
[211] J.B. Bernink, 'Onze Eerste Geologische Tocht Naar Lutte(Bij Denekamp)', *De Levende Natuur* 16 (1912): 323–27, 327 ; P. van der Lijn, 'Geologie En Mineralogie Langs de Nieuwe Wegen', *De Levende Natuur* 34, no. 6 (1929): 200–206, 235–38.
[212] J.B. Bernink, 'Onze Eerste Geologische Tocht Naar Lutte(Bij Denekamp)', 27.

for making new products. Throughout his *Boulder book* (1923), Van der Lijn also only refers to daily or industrial usages of rocks sporadically.[213]

Some articles by Van der Lijn propagate a somewhat stronger nature as resource-regime. In his 'On Flintstones', for example, Van der Lijn introduces flintstone as having been of the same cultural importance in prehistorical times as iron in the twentieth century.[214] With this 'cultural importance', Van der Lijn refers to the useful products made from flinstone that have had a big impact on human civilizations. He goes on to list a number of applications of flintstone from prehistorical tools to tinderboxes. These tinderboxes were used in combination with flintstones to spark fire. Tinderboxes were used until to the arrival of matches in the beginning of the twentieth century. Van der Lijn essentially introduces flintstone as a cultural object to spark his reader's interest. He only treats the flintstone as a natural object in the second half of the article. Here, he discusses the natural occurrence of flintstones in the Dutch landscapes and what these stones can tell you about the history of the landscape. The fact that he introduces his article with the cultural applications of flintstone, suggest that his readers were more familiar with this material in this form than as an erratic rock in nature.

A similar order of first introducing a mineral through its cultural applications and treating its natural occurrence after, is visible in Van der Lijn's article called 'Agates also as erratic stones'.[215] Herein, Van der Lijn discusses many aspects of agate including also its usage in ancient art. He explains that ancients often sculpted pictures of important events in agate. There is a picture of the Triumph of Tiberius made of agate in the Vienna Museum added in the article (see figure 7). Van der Lijn explains that museums often host many other objects made of agate such as jewellery, fruit bowls and buttons too.


Museum Weenen. Foto Georg Burg.
Echte antieke onyx-camee, de Gemma Augustea, voorstellende de Triomf van Tiberius.

Figure 7 - The Triumph of Tiberius crafted from agate

[213] P. van der Lijn, *Het Keienboek : Inleiding Bij de Studie Onzer Zwerfsteenen* (Zutphen : Thieme, 1923). Examples of usages of rock can be found on pages 6, 10, 20, 107, 157.
[214] P. Van der Lijn, 'Over Vuursteenen', *De Levende Natuur* 28, no. 12 (1924): 361–68, 361-363
[215] P. Van der Lijn, 'Achaten Ook Als Zwerfsteenen', *De Levende Natuur* 32, no. 9–10 (1928): 285–91 & 319–23, 285-286.

Van der Lijn continues his article by asking: "But what has this to do with Nature?".[216] This question implies that the reader does not associate the agate in these cultural products with the natural material it is made off. Van der Lijn, goes on to assure the reader that one can also find agates in the form of erratic stones in the landscapes surrounding him. He continued his article in his usual style by discussing how to recognize agates yourself and what geological relevance they have. In both articles by Van der Lijn, a switch from the minerals as cultural objects to minerals as natural objects can be seen. This corresponds to a switch from a strong nature as resource-regime to the usual nature as leisure-regime of Van der Lijn.

The strongest nature as resource-regime I recognized in *De Levende Natuur* appeared in an article in 1910 and was written by Eli Heimans.[217] His nature as leisure-regime and natuursport-philosophy seem to have disappeared from this article entirely. Whereas Van der Lijn still discusses mineralogy as a pursuable hobby in the second half of his articles, Heimans makes no references whatsoever on how to collect or witness these minerals in local nature. He merely discusses five different minerals and their usages. On top of that, he shows some mineralogical properties and where the material is mined.

More interestingly, however, is the fact that the article was written as an answer to a question from a reader about different minerals. The reader's questions read:

'What kind of substance is Gagat? An art product, a fabric or such a thing that does not wear out? Or a mineral? Does Asbestos, as it is used in technology, appear in the nature, or is it prepared first? How? … I would also like to know the origin of soapstone powder. … Could any of the editors or another natural scientist answer this for me.'[218]

Clearly, this reader was struggling with the question of what was considered a mineral or natural specimen and what not. He doubts whether Gagat is 'an art product' or a natural one. Similarly, he wonders whether asbestos' inflammability is inherent to the substance or whether it has been advanced by human interference in some way. Lastly, he asks for 'the origin' of a mineral. Since the reader prefers an answer by a natural scientist, this origin seems to imply the mineral's appearance in nature. The reader's question and Van der Lijn's usage of cultural products for introducing a mineral indicates a struggle of identifying the natural and cultural in the world of minerals in broader society.

In the previous chapter, I have shown that *De Levende Natuur* and Van der Lijn's *Boulder book*

[216] Ibidem, 286 „Maar eilieve, wat heeft dit nu met de Natuur uit te staan?"
[217] Eli Heimans, 'Mineralen', *De Levende Natuur*, no. 24 (1910): 563–66.
[218] Ibidem, 563 'Wat is toch Gagat voor een stof? Een kunstproduct, een weefsel of zoo iets, dat niet verslijt? Of een mineraal? Komt Asbest, zooals het in de techniek gebruikt wordt in de natuur voor, of wordt het eerst geprepareerd ? Hoe dan? … Ook van Speksteenpoeder zou ik de herkomst gaarne weten. … Wil een der redacteuren of een ander natuurkundige mij hier eens op antwoorden.'

contain a dominant nature as leisure-regime. The authors encouraged their audience to explore nature for themselves and therefore mostly discussed local nature. Local Dutch rocks, such as Van der Lijn's erratic stones, have little useful applications to them. The authors often only discussed minerals as potential input for production in passing when relevant. I found only one article about foreign nature in *De Levende Natuur* called 'A Mineralogical-Checmical Excursion'. This article describes an excursion of a group of students to several German salt- and iron ore mines and nearby chemical factories.[219] This articles contains a nature as resource-regime by explaining where different mineral come from and how the nearby factories immediately turned it into consumable goods.

In short, the works containing a strong nature as leisure-regime with a local focus, show a less strong nature as resource-regime. In Van der Lijn's articles on agates and flintstones and Heimans' article on minerals a stronger nature as resource-regime is present because they discuss the cultural uses of certain minerals elaborately. From these works we learn that, presumably, the Dutch public rarely encountered minerals before they were mined and wrought in a consumption-ready form. Heimans' article on minerals from 1910 did not propagate a nature as leisure-regime nor the natuursport-philosophy.[220] It was rather a list of five minerals and different facts about the minerals, such as their chemical composition but also their etymology. I have recognized this style of writing about minerals in other sources too. I will discuss these sources in the next section.

The Mineral 101

In the magazine articles and books that I analysed, I have recognized an often occurring tendency of authors to discuss a multiplicity of aspects of a specific type of mineral. These aspects often include the chemical and physical properties of minerals that were mentioned the first chapter on nature as order-regime. In many works, however, authors also treat other aspects of a mineral such as its etymology, where and how the mineral is mined and its potential for human usage for example. I have, therefore, coined this style of writing the Mineral 101-format. These 'fun facts' were used to make the subject more relatable and interesting for the readers. Whenever a mineral had a practical application, it was systematically mentioned in the Mineral 101-format works. Hence these works propagate a strong nature a resource-regime.

The Mineral 101-format is most prominently present in the articles of the *Album der Natuur*. Bert Theunissen has already recognized the tendency to emphasize the usage of science, and in this case nature, in his research on the *Album der Natuur* and its chief editors Pieter Harting and Hugo de

[219] anoniem, 'Een Mineralogisch-Chemische Excursie', *De Levende Natuur* 25, no. 9 (1921): 193–201.
[220] Heimans, 'Mineralen'.

Vries.[221] Theunissen argues that the magazine mostly reflected the views of these editors. Theunissen shows that Harting's initial output had a strong physicotheological character, wherein the focus was on the harmony of creation against the apparent separation of science and society. After ten years, however, this moralistic writing subsided and Harting put the emphasis on the usefulness ('t Nut) of science for people on a daily basis. Theunissen termed this focus on the usefulness of the natural sciences the 'nutsideologie' or 'usefulnessideology'. In 1885, the young biologist Hugo de Vries took over the chief editorship from Harting. According to Theunissen, this led to a big shift in the magazines' approach to the public.[222] De Vries stuck to emphasizing the usefulness of science but not just for the individual. De Vries emphasized the usefulness for society as a whole or even as propeller of progress. This shift from emphasising individual to collective benefit can also be observed in the Mineral 101-articles and in the next section on diamonds and gold.

The earliest Mineral 101-article that have I found was Harting's article mentioned in the introduction of this chapter.[223] We have seen that Harting literally stated that nature ought to be used by humans to their convenience. The remainder of his article presents a variety of properties of several minerals, including their usages. In another short article by Harting published in 1872, Harting solely discusses practical uses of the mineral asbestos.[224] He introduces the material as having been used by Vikings in the form of cloths to burn their deaths in. Furthermore, he explains that some theatres owned asbestos paper for manufacturing fireproof stage screens. Harting explains that the material can be mined in Italy in Aosta. Lastly, he suggests we should follow the example of the local priest in Aosta who drew up important documents from fireproof paper containing asbestos.

In 1892, dr. Doijer van Cleeff published another article on the impressive fireproof material in the Mineral 101-format.[225] He introduces the article by stating that the material is being shipped in huge amounts from Canada and the United States of America where it was mined on a big scale. Doijer van Cleeff then continues with its mineralogical properties, its etymology, how earlier civilizations have used the material, how the mining industry has grown explosively in the last ten years and lastly, what substance is used for in society at that point in time. For example, it was used to insulate pipes of steam factories, integrated in protective gear for workers that were subjected to fires and of course, implemented in houses and public buildings to minimize the danger of fires. He closes the article stating that asbestos has become such a big part of the trade and industry that he ought it

[221] Bert Theunissen, '"Een warm hart en een koel hoofd". Pieter Halting over wetenschap, de natie en de vooruitgang.', *BMGN - Low Countries Historical Review* 110, no. 4 (1995): 473–98 ; Bert Theunissen, 'Natuursport en Levensgeluk: Hugo de Vries, Eli Heimans en Jac. P. Thijsse', *Gewina* 16 (1993): 287–208.
[222] Theunissen, 'Natuursport en Levensgeluk', 303 ; Theunissen, '"Een warm hart en een koel hoofd". Pieter Harting over wetenschap, de natie en de vooruitgang.', 497
[223] Pieter Harting, 'De Delfstoffen, Eene Schets', *Album Der Natuur*, 1853, 13–29.
[224] P Harting, 'Het Asbest', *Album Der Natuur*, 1876, 289–90.
[225] G. Doijer van Cleeff, 'Asbest', *Album Der Natuur*, 1892, 210–21.

'not unwelcome' for his readers to get acquainted with.[226] Asbestos was just one of the many minerals discussed in the *Album der Natuur* of which the usefulness was most of all stressed. Other examples of minerals that were discussed for their usefulness are for example quartz in watches and beckolite for producing mantles.[227]

Furthermore, I have found that all the books that I studied except for Van der Lijn's work, provide lists of minerals and their different properties, histories and other fun facts. [228] Whenever applicable, authors would mention how the minerals can be used to benefit human life in these lists. In doing so, they convey a nature as resource-regime.

In his *Handbook for the Collector* (1880), Winkler discusses a multiplicity of natural objects that can be collected.[229] This way I have been able to quickly compare the chapters on collecting living nature with the chapter on minerals. In doing so, I have found that in chapters on living nature there are rarely any references to how a certain living specimen can be used to improve human welfare in the way that minerals ought to. Winkler's chapter on mineralogy is filled with practical applications of minerals. The advice of Winkler to stop by craftsman's shops for certain minerals that I have addressed in the previous chapter forms such an example. I have not compared articles of living nature with non-living nature in the magazines that I have studied. This would certainly be an interesting comparison to see whether in living nature there is indeed a less strong nature as resource-regime.

Furthermore, I found that in two books showing the daily or societal importance of minerals was even part of the main goals of the author. Von Kobell, for example, stated that he not only wants to treat mineralogy purely scientifically, but also emphasize the impact of minerals in society.[230] In Winkler's *Treasures of the Earth*, this idea is even more strongly propagated.[231] The title of the book

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[226] Idibem, 221 'de minerale vezelstof asbest reeds een zóó gewichtig artikel in handel en nijverheid geworden, dat eene nadere kennismaking er mede, naar wij hopen, aan onze lezers niet onwelkom zal zijn geweest.'
[227] See also e.g. G. Doijer van Cleeff, 'Kwartsdraden', *Album Der Natuur*, 1891, 139–42 ; R.S. Tjaden Modderman, 'Een Nieuwe Grondstof Voor de Vervaardiging van Gloeikousjes.', *Album Der Natuur* 54, no. 1 (1905): 256.
[228] Ibidem ; H. C. van Hall, *Redevoeringen over de geologie en delfstofkunde* (Groningen: Oomkes, 1840) ; Friedrich K. L. Schoedler, *Boek der natuur: algemeene beginselen der physica, astronomie, chemie, mineralogie, geologie, physiologie, botanie en zoologie* (Utrecht: Dannenfelser en Doorman, 1850) ; Franz von Kobell, *De mineralogie: populaire voordragten* (Breda: Broese & Comp., 1868) ; T. C. Winkler, *De schatten van de aardbodem* (Kruseman, 1870) ; Tiberius Cornelius Winkler, *Handboek Voor Den Verzamelaar: Een Praktisch Boek, Leerende Het Aanleggen, in Orde Maken En Onderhouden van Alle Soorten van Verzamelingen* (Sijthoff, 1880).
[229] Winkler, *Handboek Voor Den Verzamelaar: Een Praktisch Boek, Leerende Het Aanleggen, in Orde Maken En Onderhouden van Alle Soorten van Verzamelingen*, 1-77
[230] Kobell, *De mineralogie*, 51 'Daar wij ons niet zoo zeer voorstellen de mineralogie alleen zuiver wetenschappelijk te behandelen , als wel op eene algemeen verstaanbare wijze een overzigt van het rijk der steenen te geven en hunne aanwending in het dagelijksch leven te vermelden , zoo is in de volgende hoofdstukken de volgorde van behandeling en de keuze der mineralen daarnaar geregeld.'
[231] Winkler, *De schatten van de aardbodem*.

already suggests that Winkler saw minerals as the treasures of earth. Winkler introduces his book by stating:

> 'I have tried my best to describe, in a language intelligible for everyone, the minerals as they occur in daily life, as they are being used to serve society, in one word how they deserve to be known by everyone who wants to make a claim on the title of a civilized man.'[232]

Winkler argues that one of the goals of his study was to describe minerals as they occur in his audience's daily lives and in service of society. He even claims that it is this bit of information, the usage of minerals to the benefit of individuals and society, that every civilized man ought to know. As I mentioned in the first chapter on the nature as order-regime, Winkler refrains in this book from discussing dull mineralogical formulas and chemical structures. He did not mention these properties in his list of different minerals. He did not see this as knowledge the broad public should possess about minerals.

In short, a large amount of written popular mineralogy was written according a Mineral 101-format that discussed several aspects of a specific type of mineral. One aspect that was often addressed was the usefulness of the mineral in one's daily life or society as a whole. Mentioning the usefulness of a mineral, whether in passing or as the central goal, was near universal in all the sources that I have studied throughout the period concerned. In this way, the authors established a strong nature as resource-regime in their works. Some Mineral 101 articles and all Mineral 101 books except Winkler's *Treasures of the Earth* also mentioned different classificatory characteristics of minerals such as their chemical composition. Herein, we can observe some overlap of the nature as resource-regime with the nature as order-regime.

Mining (black) gold and diamonds

The nature as resource-regime is most strongly present in articles and on site-activities about three specific minerals that received a lot of attention in popular culture, namely gold, diamonds and coal. Gold and diamonds do not occur in the Dutch mainland soils. Since *De Levende Natuur* mostly focussed on popularising local and national nature, this magazine therefore lacks articles on gold and diamonds. Furthermore, coal was only present in the Netherlands in the province of Limburg in relatively small amounts. The articles on coal I was able to find in *De Levende Natuur,* however, only treated the geological features of the substance.[233]

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[232] Ibidem, 2 'Ik heb mijn best gedaan om in ieder verstaanbare taal de voornaamste delfstoffen te beschrijven, zoals zij vorkomen in het dagelijksche leven, zooals zij gebruikt worden ten nutte van de maatschappij, in één woord zooals zij verdiend gekend te worden door elk die op den naam van beschaafd mensch aanspraak wenscht te maken.'

[233] See e.g. J.A.J.M. Van Waterschoot van der Gracht, 'Schetsen Uit Een Zeer Ver Verleden. II. Het Steenkolentijdvak', *De Levende Natuur*, no. 15 (1911): 412–14.

Diamonds, gold and coal did, occur in big quantities in the former Dutch colonies and other overseas territories with a close relation to the Netherlands. The *Album der Natuur* had a more international approach. They published multiple series of articles on gold, diamonds and coal. In these articles, an immensely dominant nature as resource-regime can be seen with coal as fuel for industrial society.[234] In an article by dr. Snijders, for example, coal is introduced as the most important mineral for modern society given by us by nature stating:

> 'Nature certainly does not provide us with any substance that exerts a larger influence on our existence and on the whole of human society, than coal. How insignificant industry and engineering would be without this vital fuel, how imperfect our lighting and heating, how primitive our means of transportation, were we to miss the coal! ... It is therefore not wrong to call coal "the black gold".'[235]

Snijders calls coal 'the black gold' because it was so essential for industrial society. It was used as fuel for industry, transport, lighting, heating and more.

Considering coal's importance for the industrial society and the ever growing demand in the nineteenth century, some authors expressed their concerns on the European stockpiles of the resource.[236] In an article titled 'The Coal Question' the rapidly reducing English stockpiles are discussed.[237] The author, Pieter Harting, explains that if the global demands would keep growing, England would soon lose its leading trading position to other countries such as the United States. He suggests that a maximum annual consumption might need to be installed. However, Harting does not expect the demand for coals to keep growing as rapidly that it will run out globally. His concern was limited to the economic power of England. It was expected that the earth would only start running out of coal in hundreds to thousands of years. Harting argues that even when the time does come that the stocks do run out, the resourceful human mind will find new sources of energy, stating: 'Society itself

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[234] Harting, 'De Engelsche Kolenmijnen' ; onbekend, 'Het Steenkolen-Vraagstuk', *Album Der Natuur*, 1867, 245–49 ; R.E. Haan, 'Het Steenkolen-Tijdperk', *Album Der Natuur* 1, no. 17 (1868): 257–68 ; onbekend, 'Steenkolen in Engelsch Indie', *Album Der Natuur*, 1868, 224 ; B. Van der Meulen, 'Steenkolen, Een Goudmijn Aan Kleuren', *Album Der Natuur*, 1876, 323–40 ; A.A. Rijk, 'Iets over Koolstof', *Album Der Natuur*, 1881, 180–90 ; A.J.C. Snijders, 'De Vorming Der Steenkool', *Album Der Natuur*, 1885, 16–33.

[235] Snijders, 'De Vorming Der Steenkool', 16. 'De natuur levert ons zeker geene enkele stof op, die een grooteren
invloed uitoefent op ons bestaan en op de geheele menschelijke samenleving, dan de steenkool. Hoe onbeteekenend zouden industrie en techniek zonder deze belangrijke brandstof zijn, hoe onvolkomen zouden onze verlichting en verwarming, hoe primitief onze middelen van verkeer zijn, indien wij de steenkool moesten missen! ... Niet ten onrechte noemde men dus de steenkool wel »het zwarte goud".'

[236] See onbekend, 'De Engelsche Kolenmijnen'; onbekend, 'Steenkolen in Engelsch Indie', Van der Meulen, 'Steenkolen, Een Goudmijn Aan Kleuren' ; Snijders, 'De Vorming Der Steenkool'.

[237] onbekend, 'Het Steenkolen-Vraagstuk'.

will never become a fossil.'[238] Six years after Harting's article a small announcement in the *Album der Natuur* appeared which stated that a coal field had been discovered of 1200 square miles in the former British Indian Empire.[239] The announcement states it is a very welcome surprise considering the gradual depletion of the stockpiles on the British Isles.

Like Great Britain, the Netherlands also had access to minerals in their former colonies. Therewith, the mineral wealth of overseas territories was an often discussed topic in popular mineralogy in the Netherlands.[240] In 1861, an article appeared on the mineralogical wealth of the former Dutch Indies, modern-day Indonesia.[241] The articles states that the Dutch Indies soils were rich in minerals such as cupper, tin and iron. Yet, the mines were located in areas that did not possess proper infrastructure to make the mines profitable. However, the Dutch did mine coal locally for the steamboats active in the local trade on the Indonesian rivers and seas.

As Mr. Rijk points out in an article from 1881, coal and diamonds are made of the same material, namely carbon.[242] Yet, they look nothing alike, have very different uses and occur in other regions of the world. Diamonds were not useful for broad society in the way coal or other minerals were. Yet, they were seen as raw materials that could be shaped into object for human usage such as jewellery. Diamonds were often discussed in popular mineralogy in *Artis* in the 1880 and 1890s.[243] From an article on the mountain village Septmoncel, we learn that diamonds were very popular in Amsterdam specifically.[244] Amsterdam was the world's leading city in diamond cutting and polishing in the late nineteenth-century.[245] Since diamond is the hardest natural substance available, it was very difficult to polish. From the article we learn that the people of Amsterdam took much pride in their craftmanship.

I have already pointed to the first efforts of making diamonds in the chemical industry at the end of the nineteenth century in the introduction.[246] These illustrate one of the regimes of nature that

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[238] onbekend, 'Het Steenkolen-Vraagstuk', 249 'Tegen den tijd, dat de steenkolen schaarsch worden, zal de menschelijke vindingsgeest nieuwe bronnen van warmte en beweging ontdekt hebben. De beschaving zelve zal nimmer fossil worden.'

[239] Harting, 'Steenkolen in Engelsch Indie',

[240] For more information on the mining practices in the former Dutch colonies see e.g. Peter de Ruiter, 'Het Mijnwezen in Nederlands-Oost-Indië 1850-1950' (2016) ; Wim Ravestein and Jan Kop, eds., *For Profit and Prosperity: The Contribution Made by Dutch Engineers to Public Works in Indonesia, 1800-2000*, *For Profit and Prosperity* (Brill, 2008).

[241] onbekend, 'De Mineraal-Rijkdom van Indië', 126-127

[242] Rijk, 'Iets over Koolstof', 180-183

[243] See e.g. F.W. Krecke, 'Diamantvelden in Zuid-Afrika', *Album Der Natuur*, 1878, 239–46.

[244] H.M.C. Oosterzee, 'Septmoncel', *Album Der Natuur*, 1859, 310–18, 310.

[245] For more information see: Saskia Coenen Snyder, '"As Long as It Sparkles!": The Diamond Industry in Nineteenth-Century Amsterdam', *Jewish Social Studies* 22, no. 2 (2017): 38–73, https://doi.org/10.2979/jewisocistud.22.2.02.

[246] See W.M. Logeman, 'Diamanten Maken', *Album Der Natuur*, 1880, 150–58. ; G. Doijer van Cleeff, 'Hoe Moissan Tot de Vorming van Diamant Geleid Werd', *Album Der Natuur* 42 (1893): 369–77.

Arturo Escobar coined, namely technonature.[247] In this regime, nature is synthesized by humans themselves. The developments around synthesizing diamonds, however, were only in their infancy at the end of the twentieth century. Looking at the articles from the *Album der Natuur*, we learn that diamonds were still mined in regions that held a close relation to the Netherlands.

One article dedicated to diamonds that appeared in 1907 shows a nature as resource-regime.[248] In this article, S.H. Junius gives an entertaining chronological overview of the discovery of diamonds in the soils of the former Republic of the Transvaal. The Republic of the Transvaal was located in the modern day Province of Transvaal in South-Africa. It was founded in 1852 by Dutch-speaking farmers with roots in the Netherlands. The republic and the Netherlands kept close connections to each other as appears from this article also. The Transvaal region was very rich in all sorts of minerals.

Mr. Junius was a citizen of the Transvaal himself.[249] He describes that his neighbour Mr. Van Niekerk had brought a visit to a nearby farmers family and saw the children playing with shiny rocks: diamonds. With permission and the agreement to share the profits, he took the diamonds to an expert in the Netherlands and they appeared to be 22.5 carat, worth six thousand guilders. The rumour spread fast and people from all walks of life from farmers to well-off school boys went out to look for what they called 'blinkklippies'. The author noticed that in this early period, people of colour sold their specimen for much less than the profits the European traders generally made. Around the end of the century, Junius explains, this small scale searching was taken over by big European companies with efficient machinery to mine on a large scale and underground. In these mines, over nineteen thousand local people worked and slept in tents near the mines. Soon the 'diamond city' of Kimberly was founded which had separate neighbourhoods for the labourers.

The diamonds in the South African mines also proved a popular subject for public lectures given in *Artis* by the professor of geology of the University of Amsterdam Gustaaf Molengraaf.[250] From a newspaper article we learn that prof. Molengraaff's fourth public lecture in 1893 was about diamonds. His audience for this lecture had been even bigger than the numbers of visitors of the previous lectures. This was because the main subject of the talk was the diamond, the author of the newspaper article claims. Molengraaff taught his audience about the history of tracing diamonds in landscapes and how to shape them into useable products. Lastly, he told his audiences about the South African diamonds mines and his own experiences there. Considering this content, the lecture propagated a strong nature as resource-regime.

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[247] Arturo Escobar, 'After Nature: Steps to an Antiessentialist Political Ecology', Current Anthropology 40, no. 1 (February 1999): 1–30, https://doi.org/10.1086/515799, 9.
[248] S.H. Junius, 'Iets over Diamanten - Kimberly', 363–73.
[249] Ibidem, 363-373
[250] 'Stadsnieuws.', 11 March 1893

On top of these four public lectures, Molengraaff gave several other lectures on geology and the mining industry elsewhere as well. During the fifth Dutch Congress for Natural Sciences and Medicine in 1895, for example, Molengraaff gave a presentation on his geological expedition in Borneo.[251] The opening of this congress was held at *Artis* and also the concluding dinner was held here. Participation cost three guilders and included entrance to the zoo and its museums. Molengraaff himself held his presentation in the Building for the Working Class in Amsterdam. He accompanied his presentation with light images.

From a review in the popular magazine *De Gids* from 1900 on Molengraaff's book on his expedition in Borneo, we learn that his speech in 1895 was very well received and his audience had been very varied.[252] There had been an 'unusual amount' of ladies present, but also farmers, pharmacists, teachers and professors. According to the reviewer, Mr. J.F. Niermeyer, Molengraaff did an excellent job, presenting in a witty and uplifting manner. The lecture was a short summary of Molengraaff's book. The book itself tells everything about the expedition from the first ideas of going to Borneo to their arrival in the Netherlands again. Molengraaff's loving and arty way of describing the rocks he found, awakens similar sentiments for rocks for the reader, the reviewer states. Niermeyer even states that this book might reignite the lust for constructing mineralogical cabinets again.[253]

From another newspaper article in 1901, we learn that Molengraaff also gave a lecture on 'The Transvaal as gold land'.[254] I have not found the exact contents of this lecture, but the title might speak for itself. In four articles on gold in *The Album der Natuur,* a nature as resource-regime was communicated. Between 1878 and 1889, four articles on foreign gold mines were published, three of which were about the gold mines on the African continent, including the Transvaal region. [255] The other region concerns the mainland of Australia called New Holland. The Dutch never actively colonised this area but have had several settlements in the area. In short, these articles on gold mining discussed locations where the Dutch audience felt a historical or colonial connection to. This presumably increased the appeal of the articles for the Dutch public.

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[251] 'Vijfde Natuur- en Geneeskundig Congres te Amsterdam', *Dagblad van Zuidholland en 's Gravenhage*, 4 May 1895, https://www.delpher.nl/nl/kranten/view?coll=ddd&identifier=MMKB19:003607173:mpeg21:a00059.
[252] F.J. Niermeyer, 'Borneo Expeditie. Geologische verkenningstochten in Centraal-Borneo, door Dr. G.A.F. Molengraaff, oud-Hoogleeraar aan de Universiteit te Amsterdam, staats-geoloog der Zuid-Afrikaansche Republiek. Met Atlas. Leiden-Amsterdam, 1900.', *De Gids.* (DBNL, 1900), https://www.dbnl.org/tekst/_gid001190101_01/_gid001190101_01_0083.php.
[253] Ibidem, 250-251 'Wie weet of dit boek niet bestemd is den lust tot het aanleggen van mineralogische kabinetten te doen herleven, die met de achttiende eeuw verdwenen is;… .'
[254] 'Stadsnieuws', *Het nieuws van den dag : kleine courant*, 20 February 1901, https://www.delpher.nl/nl/kranten/view?coll=ddd&identifier=ddd:010128122:mpeg21:a0148.
[255] R.E. De Haan, 'De Goudvelden van Australië', *Album Der Natuur* 28, no. 1 (1879): 210–18. ; R.E. Haan, 'Goudvelden van Wassa in Afrika', *Album Der Natuur*, 1880, 371–78. ; P Harting, 'Het Transvaalsche Goud', *Album Der Natuur*, 1884, 18–24. ; G. Doijer van Cleeff, 'Goudvelden in de Transvaal', *Album Der Natuur*, 1889, 162–66.

In the articles, it is explained that gold and other precious metals were to be exploited for society's sake to make great profits off. Gold was appreciated for its looks, but also for its functionality. R.E. de Haan, for example, claims in his article on gold:

> 'The clean colour and shine, which are durable to resist influences, for which almost all others metal fail, easy malleability and other advantageous technical properties, … , have imparted a value to this metal that has persisted undisturbed from the earliest times to the present day.'[256]

De Haan explains that gold is a so-called precious metal that is resistant to corrosion and oxidation. Yet, no precise applications of gold are mentioned in this article nor in the other three. In sum, I have shown that the nature as resource-regime is very dominant in sources of popular mineralogy that discuss coal, gold and diamonds. The value of coal was presented as a very practical one since it was seen as the fuel for modern society. The value of diamonds and gold was mainly aesthetic and economic. The authors claimed these materials were all to be delved to increase the overall wealth of society. The minerals cannot be mined in the Dutch mainland soils, however. Popularisers therefore mainly discussed mines in the former Dutch colonies or where the Dutch audience was familiar with historically. In the next paragraph, I will show that the ways in which minerals were exhibited around *Artis* also propagated a nature as resource-regime. Minerals were often put on display as being raw materials suitable for production.

Resources on site

As I have mentioned before, I have not been able to find how and in which context the mineralogical collection of *Artis* was put on display on the zoo's grounds. I only found that the minerals in *Artis* were located in the Natural History Museum, the library's west wing and the ethnographical museum between 1838 and 1938. Therefore, I will turn to two exhibitions that hosted material of *Artis* or held close relations to *Artis* in other ways. These give an impression on how *Artis* might have exhibited its collections, especially in the Ethnographical Museum. Lastly, I will discuss an exhibition held in 1934 in *Artis* in which rocks were used in the décor of an exhibition on nature. I argue that using rocks as a building material for the backdrop of living nature also testifies to a dominant nature as resource-regime in popular mineralogy.

One exhibition that presented a nature as resource-regime is the Netherland's first world exhibition held in 1883 in Amsterdam. The exhibition was called the International Colonial and Export Exhibition. *Artis* had donated several objects of their zoological cabinet and objects for religious rituals

[256] De Haan, 'De Goudvelden van Australië', 211 De schoone kleur en glans, die duurzaam weerstand bieden aan invloeden, waarvoor schier alle andere metalen bezwijken, de gemakkelijke smeedbaarheid en andere voordeelige technische eigenschappen, anderdeels eene stilzwijgende overeenstemming, hebben aan dit metaal eene waarde verleend, die ongestoord bleef stand houden van de vroegste tijden tot op heden.'

from their ethnographical collection.[257] According to Marieke Bloembergen, the exhibition was held to present the Dutch colonial riches and merchandise.[258] Showing off a country's colonial natural riches had been standard practice since the first world exhibition in Londen in 1851. Elizabeth Ferry also recognized this way of exhibiting minerals in the Centennial Exhibition in Philadelphia.[259] In Philedelphia a system of organization for exhibits was put into place that moved from basic raw material to objects made from these materials. Minerals were thus displayed as raw materials for production of other objects.

In the catalogue of the 1883 exhibition, we find that the Amsterdam exhibition shows a similar organization.[260] Visitors of the exhibition would first encounter raw natural objects from the former Dutch colonies. The first group of natural objects presented were rocks and minerals. At the entrance, an overview of different geological strata in Dutch colonies were laid out in chronological order.[261] Secondly, the minerals found in the soils of the former East- and West Indian colonies were exhibited.[262] The different specimen were either taken from the collection of the Natural History Museum in Leiden or sent in by the head mining engineers from colonial territories. The title of the explanation of the minerals in the catalogue is 'Useful Minerals'. The catalogue goes on to explain that the soils are not rich enough in minerals to make profitable mines in the area, except for gold- and tin ore in some regions. A similar lay-out is maintained for the botanical and zoological specimen on display, followed by products made from these raw materials.

Frederik van Eeden, a well-known populariser of nature in the second half of the nineteenth century, wrote weekly reports on the world exhibition for a local newspaper. On the 15th of October 1883, he wrote about the minerals at the exhibition.[263] He says that the minerals exhibited provided a nice overview of those minerals 'that are exploited to advantage by the Dutch: tin and coals.' Van Eeden, furthermore, writes about the mining industry in the Dutch Indies and Surinam. He argues, however, that the Dutch scientists should explore its colonial lands much more and asks the state to fund this research better. Van Eeden claims that these investments would pay back in tenfold. Overall, as the title of the exhibition already suggests, the International Colonial and Export Exhibition in

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[257] Ibidem, 190 & 329
[258] Marieke Bloembergen, 'De Koloniale Vertoning: Nederland En Indië Op de Wereldtentoonstellingen (1880-1931)' (Amsterdam, Wereldbibliotheek, 2002), 1-2.
[259] Ferry, '"Ziegfeld Girls Coming Down A Runway"', 34-35.
[260] Afdeeling Nederlandsche Koloniën, *Catalogus Der Afdeeling Nederlandsche Koloniën van de Internationale Koloniale En Uitvoerhandel Tentoonstelling Te Amsterdam* (Leiden: E.J. Brill, 1883).
[261] Ibidem, 70-77
[262] Ibidem 77-79
[263] Frederik Van Eeden, 'Internationale Tentoonsteling De Koloniale Afdeling XIV.', *Het nieuws van den dag : kleine courant*, 15 October 1883, https://www.delpher.nl/nl/kranten/view?coll=ddd&identifier=ddd:010065118:mpeg21:a0059. '…, welke inzonderheid door de Nederlanders met voordeel worden geëxploiteerd: tin en steenkolen.'

Amsterdam in 1883 respired a nature as resource-regime.

Bloembergen explains that following the International Colonial and Export Exhibition, a committee was set up to found a Dutch Colonial Association (Nederlandsche Koloniale Vereeniging).[264] They strove to awaken and keep alive the interest in the colonies among more citizens. Yet, this attempt failed and the collection that this committee had gathered were donated to *Artis'* Ethnographical Museum. Part of this collection had also been on display in the 1883 exhibition. In 1910, another committee succeeded in founding the Colonial Institute (Koloniaal Instituut). The Colonial Institute took up *Artis'* ethnographic collections and the collections of the Colonial Museum (Koloniaal Museum) in Haarlem of which Frederik van Eeden was the director.

The guide of the Colonial Museum from 1882 shows a clear nature as resource-regime present in its exhibitions too.[265] The first objects one encountered in the museum were minerals from the Dutch Indies. The catalogue has a Mineral 101-format, presenting different facts about the different minerals such as mineralogical properties but more so where they were mined, how much profits are yielded from them annually and what the local inhabitants used it for. The next cabinets were filled with different foods, medicinal barks and dried plants, types of wood and more natural products from the Dutch Indies. They were all presented as resources for useful products in society. The natural specimen were often followed or accompanied by objects crafted the same material by native people of Indonesia. Perhaps the minerals in the ethnographical museum of *Artis* were displayed in a similar manner as raw material or resource as in the Colonial Museum or the International Colonial and Export Exhibition.

In 1934 *Artis* hosted a big exhibition called the Natural History Exhibition.[266] In a newspaper article from April 1934, the preparations for this outdoor exhibition are announced. From the article we learn that the goal of the exhibition was to take the visitor across small fabricated landscapes that were meant to represent one geographical area of the world. The entire exhibition would take you all over the world from the Dutch dunes to Mexico, South Africa, Indonesia, Japan, China, Central Asia and via North-America back to the European mountains. The article states that the exhibition will show the flora and fauna present in these areas, stating: 'Everything will be decorated with plants and animals.' Many of the plants, such as the Mexican cacti, were alive and most animals stuffed. There appears to be little attention for the specific types of rocks and sands in these different areas, however. The article only mentions the workers building the backdrops of the different landscapes

[264] Bloembergen, 'De Koloniale Vertoning', 86
[265] F.W. van Eeden, *Koloniaal museum op het Paviljoen bij Haarlem: overzicht van het museum als leiddraad voor de bezoekers* (Loosjes, 1882).
[266] onbekend, 'De Nat.-Historische Tentoonstelling in Artis', *De Telegraaf*, 14 April 1934, https://www.delpher.nl/nl/kranten/view?coll=ddd&identifier=ddd:110572077:mpeg21:a0092. 'Het geheel zal aangekleed worden met plant en dier.'

using some rock materials.

All the paths would be made from flagstones and boulders from no specific kind are used for the Asian high planes.[267] Moreover, peat litter and sand are used for creating the planes and deserts and asphalt paper forms the swamps and deep ravines of the Indonesian rainforest. The materials appear to have no relation to the geographical area like the plants and animals do. Herein, we see another sign that the new popular natural history was mainly focussed on living nature and often excluded non-living nature in their ecological views. More importantly, using the non-living nature merely as a building material for building the decors testifies of a strong nature as resource-regime among the exhibition makers. The exhibition makers saw the non-living materials merely as raw substances as input for the production of their décor.

Conclusion

All in all, in the popularisation of minerals between 1838 and 1938 with *Artis* as a socio-scientific hub, there is a universal nature as resource-regime present. Since the Dutch mainland soils are very poor in minerals, the Dutch audience rarely encountered minerals in nature and only in a modified consumable form. In the magazines and books available in the *Artis* library and in several exhibitions in or nearby *Artis*, minerals are most of all presented as resources that should be used to benefit human life. From various articles and books, we learn that precious minerals were to be extracted for jewellery or general wealth accumulation. Many other minerals were beneficial in making our rooftops fireproof and fuelling our industry for example. It is not unlikely that the minerals in the Ethnographical Museum in *Artis* were exhibited as raw material for production as well.

[267] onbekend, 'De Nat.-Historische Tentoonstelling in Artis', *De Telegraaf*, 14 April 1934, https://www.delpher.nl/nl/kranten/view?coll=ddd&identifier=ddd:110572077:mpeg21:a0092. 'Het geheel zal aangekleed worden met plant en dier.'

CONCLUSION: A NATURE-CULTURE SMELT

This research looked at the ideas of nature in popular mineralogy between 1838 and 1938 with *Artis Natura Magistra* as the socio-scientific hub. *Artis* forms an interesting hub because the society undertook a wide variety of activities to popularise the subject, from lending magazines and books from their library to exhibiting minerals and giving lectures on site. I have analysed the ideas of nature present in these sources using the concept of regimes of nature. These function as a framework for investigating the manifold forms the natural can take. I have found three regimes of nature, namely nature as order, nature as leisure and nature as resource.

The nature as order-regime is a view of nature in which nature is seen as a set of natural laws that can be discovered through close observation and comparison. It is the regime of nature that governs 'old' natural history mineralogists who had creating taxonomic systems as their main goal. The regime is primarily visible in books on mineralogy before 1870 through the urge of the authors to order nature according to regularities that minerals display. The nature as order-regime often went hand-in-hand with a physicotheological view of nature wherein these laws were thought to be installed by the Creator, but not necessarily so. Especially the crystal structures that minerals display lend themselves well in illustrating the laws according to which minerals form. In several early twentieth-century exhibitions of minerals and crystal structure models, we can see a continuation of the regime. To able to understand the natural laws in mineralogy, however, the public was required to possess a lot of knowledge on chemistry and geometry. More importantly, if amateurs wanted to discover natural laws for themselves they had to possess a collection of minerals. Considering the poor availability of minerals in the Dutch soils, these were not easy to come by.

In the nature as leisure-regime, authors tried to improve the accessibility of mineralogy for amateurs. The nature as leisure-regime is closely tied to the natuursport-philosophy around the turn of the century in which nature was seen as an enjoyable activity through going outdoors and creating ones own collection of natural objects. The authors in this regime encouraged their readers to go out in nature to behold minerals and rocks in their natural environment. This regime proved very popular in the study of living nature in the Netherlands. To overcome the lack of minerals in the Dutch soils, the authors gave tips on where to collect stones, such as alongside roads or in (work)shops. Pieter van der Lijn resorted to so-called erratic stones that can be found scattered around in landscapes in the Netherlands. Most authors from the nature as leisure-regime, however, had as their main goal informing the audience about the history of the local landscapes through the study of rocks. They saw mineralogy as a mandatory step for identifying their rocks to quickly move on the historical value of the rock.

The last regime of nature in popular mineralogy is 'nature as resource'. Herein, nature is seen as potential input for production of goods. This regime was present in almost all the sources that I

have studied in various degrees. It was least present in the sources that displayed a strong nature as leisure- regime and most dominant in the articles in the *Album der Natuur* on gold, diamonds and coal and two colonial exhibitions near *Artis.* In the nature as resource-regime the usefulness of minerals in the form of cultural products is emphasized. In many cases, cultural products made of minerals are used by authors to introduce a mineral to the public. Apparently, the Dutch public was more familiar with the applications of minerals than with the raw material itself.

In popular mineralogy between 1838 and 1938 with *Artis Natura Magistra* as the socio-scientific hub, we can observe what I have called a nature-culture smelt. Considering the lack of minerals in the Dutch soils, the Dutch audience rarely interacted with minerals in their natural environments. When they did encounter minerals, it was often in a ready-made, consumable form. Therefore, the Dutch audience seemed to relate better to the cultural applications of minerals. The nature-culture dichotomy ceases in the popular mineralogy. Instead, nature and culture fused into a nature-culture smelt.

To further strengthen this argument, it would be interesting for future researchers to look at popular mineralogy abroad in areas where the public did encounter minerals in their natural surroundings. Did the public here also see minerals mainly as input for production? On top of that, it would be interesting to look at the regimes of nature in the popularisation in living nature. I have come across several clues that suggest that in the popularisation of living nature, the nature as resource-regime is less dominant. For example, in Winkler's *Handbook for the collector* and the Natural History Exhibition held in 1934 in *Artis,* rocks were used as buildings materials whilst animals and plants were collected and displayed for pleasure.

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