Afterword · SVEN WIDMALM

In November 1749, a sperm whale was found drifting in Habyfjorden, close to Hunnebostrand in Bohuslän, in southern Sweden. The find was described by Johan Mauritz Klinckowström, a colonel with an interest in natural history, who was stationed in Strömstad. At the end of January 1750, Carl Linnaeus received a sketch of the whale and its jawbone (or possibly the entire skull). Linnaeus, who had had previous contacts with Klinckowström, thanked him kindly, but also had opinions demonstrating the complications of dealing with whales scientifically:

> Animals preserved in alcohol will be preserved; also all kinds of jellyfish and seacalves; Nothing can be salvaged from the larger animals, if one does not have small ones of the same likeness.
>
> The smallest and most insignificant sea creatures are the rarest and most interesting to naturalists. All kinds of mussels and shells should and could be preserved with the animal itself in alcohol; especially if they are not yet properly described [---]
>
> There are many types of whales, and unusual animals, by few described and inadequately so; that mentioned appears not to have been so depicted that one can be sure of the species.
>
> I am very pleased that such a renowned Gentleman wishes to display such interest in those things generally despised by our Compatriots, though the Creator himself has made them for our pleasure and our benefit [...].

Two contemporaneous representations of the stranded sperm whale confirm the difficulty of assessing whales in a scientific manner (see p. 621). They were not made on site, but seem to originate from a verbal description ("from information obtained"). Both have obvious errors as regards body shape and anatomical details. For a professional natural historian, small animals that could be preserved in alcohol and studied indoors were much easier to manage, particularly if it was the first time they were to be described in a scientifically correct manner. Still, Linnaeus probably appreciated both pictures and bones and flattered the noble colonel, who understood the point of what we would call scientific research, a holy duty that united business with pleasure.

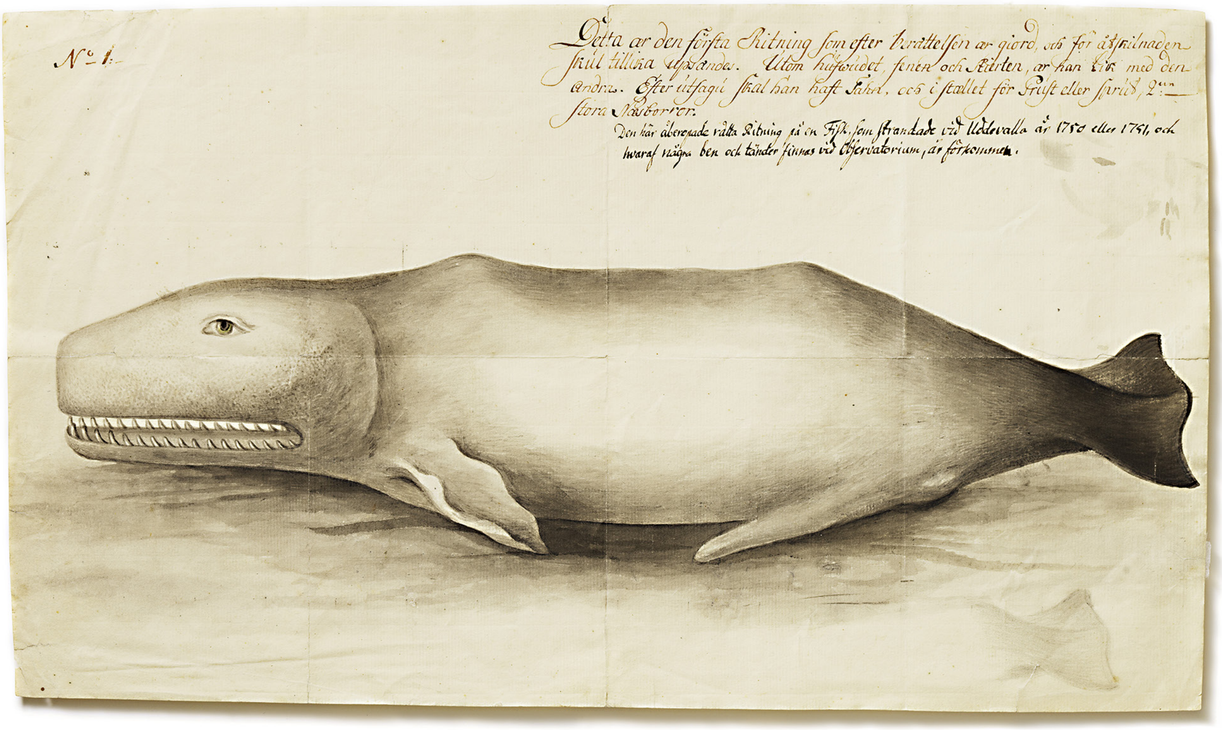
The whale seems to have been primarily pleasure. The bones were sent to the Academy of Sciences in December; they were displayed to the public at Riddarhuset, the House of Nobility, after which they were moved to the observatory. In time, they came to be decoration in the park owned by an ornithology enthusiast, Gustaf von Carlson. Both Klinckowström and von Carlson donated collections to the Academy. Aristocratic lovers of science such as these were at the heart of the early scientific academies; they represented the Enlightenment's view of knowledge dissemination, which was greatly dependent on the good example of the spiritual and worldly upper classes. Because the Academy also aimed at a wider public to obtain new "findings", not least through prize competitions, one could say that there was a vision of knowledge circulation – between the higher and lower estates.

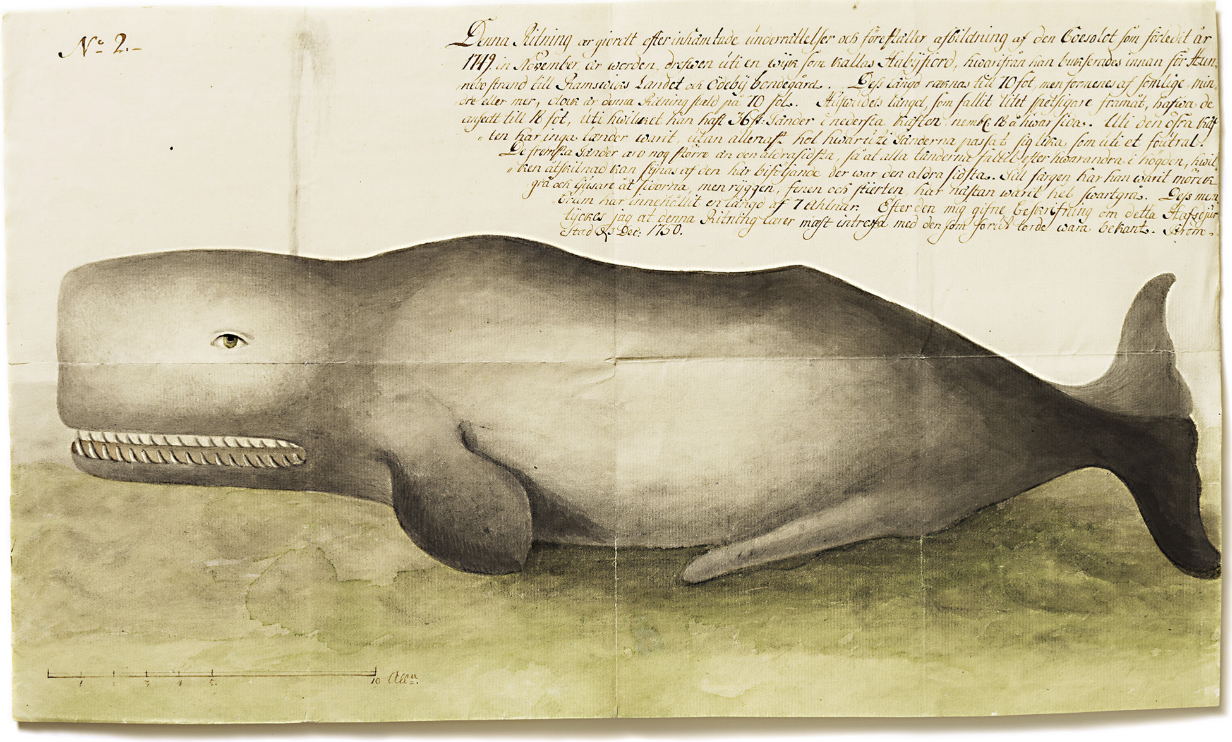
There is no doubt that Linnaeus was fascinated by the scientifically troublesome whales. Above the door of his bed chamber in Hammarby there was an ink wash of a beaked whale that had stranded in the same month as the sperm whale in Bohuslän, in Fredrikshald (now Halden) in Norway. The suggestion made by Klaus Barthelmess and Ingvar Svanberg is possibly true, namely that Linnaeus was inspired by this picture – which includes a calf with the remnants of an umbilical cord – when he changed the classification of whales from fish to mammal. But otherwise he was not scientifically concerned with whales. As he stated himself, pictures or verbal descriptions constitute a very fragile basis for scientific assessments.

These indirect meetings between Linnaeus and the whales exemplify important aspects of the conditions of early modern science, which are also touched on in Henrik Björck's and Thomas Kaiserfeld's historical overview and in several of the picture essays. In the mid-18th century, science was not only systematic; in important regards it was on the way to creating an essentially artificial image of nature – attractive because it could be reduced to abstract principles. This applied to Linnaeus, whose systematics were a practical tool and an abstraction rather than (as he himself had wished) a

DRAWING OF THE "FISH" said to have stranded in Uddevalla in 1750 or 1751. The text was not written on site, but according to a description, so both the information and its appearance are uncertain.

WATERCOLOUR based on the submitted original. The fish has now been identified as a sperm whale, and it has been clarified that it stranded in 1749.


N:o 1.
Detta är den första Ritning som efter berättelsen är giord, och för åtskilnaden
skull tillika uppsändes. Utom hufwudet, fenen och Stjerten, är han lik med den
andra. Efter utsagu skal han haft Tähn, och i stället för Prust eller Sprutt, 2:ne
stora Näsborror.
Den här åberopade rätta Ritning på en Fisk, som strandade vid Uddevalla år 1750 eller 1751, och
hwaraf några ben och tänder finnas vid Observatorium, är förkommen.


N:o 2.
Denna Ritning är giordt efter inhämtade underrättelser och föreställer afbildning af den Coesolot som förledit år
1749. in November är worden, drifwen uti en wijk som kallas Habyfiord, hwarifrån han buxserades innan för Stun,
nebo strand till Ramsvics Landet och Ödeby bondegård. Dess längd räknas till 70 fot, men fornenes af somlige min,
dre eller mer, dock är denna Ritning ställd på 70 fot. Hufwudets längd, som fallit litet spetsigare framåt, hafwa de
ansedt till 18 fot, uti hwilket han haft 36 st: Tänder i nedersta käften, nembl: 18 å hwar sida. Uti den öfra käf
ten har inga tänder warit, utan allenast hol hwaruti Tänderna passat sig lika som uti et foutral.
De fremsta Tänder äro nog större än den aldrasidsta, så at alla tänderna fallit efter hwarandra i högden, hwil
ken åtskilnad kan synas af den här bifogande der war den aldra sidsta. Till färgen har han warit mörck
grå och gusare åt sidorna, men ryggen, fenen och stjerten, har nästan warit hel swartgrå. Dess men
brum har innehållit en längd af 7 ahlnar. Efter den mig gifne beskrifning om detta Hafsdjur
tyckes jag at denna Ritning lärer mäst intreffa med den som förut torde wara bekant. Ström
Stad d. 5 Dec: 1750.
10 Aln:

reproduction of the natural, and thus divine, order. At the same time, mathematicians, astronomers and cartographers were fully occupied with reducing the image of the Earth's surface and the heavens to mathematical abstractions. Newton's laws, the development of new mathematical tools, the growth of advanced precision measurement techniques and, not least, increased international cooperation made this possible. Chemists engaged in the same kind of reductionism for dead matter. Alchemy had laid the foundation of an organic view of matter, but was abandoned in the 18th century in favour of the study of chemical reactions, the construction of affinity tables and mathematics-like reaction formulas. Academy members such as Torbern Bergman, Jacob Berzelius, and later Svante Arrhenius, made important contributions to this development. Physics followed the same path. During the 18th century it was less mathematically and technically advanced than astronomy, but in the 19th century it gradually increased its claim on being the most fundamental among the natural sciences. This position was definitely established in association with the scientific revolution that began with the formalising of electromagnetism in the 1860s and was completed with the establishment of quantum mechanics and the theory of relativity in the 1920s. In the 19th century, the three kingdoms of nature were subject to systematic attempts at abstraction, with Alexander von Humboldt as a figurehead for a global approach to precision measurement and the systematic description of flora and fauna. Linnaeus and his apostles were early starters in that regard.

The knowledge society expanded in the 19th century, with the help of increased data collection and more exact methods for both the measurement and management of data. For example, at the Academy this was noticeable through the growth of the natural history collections, involvement in scientific expeditions and increasingly expansive international cooperation. Science marched in time with industrialism and colonialism. One consequence was that the abstract yarn of scientific analysis was spun around increasingly large areas of terrestrial nature. Flora and fauna were not only studied in herbaria and jars of alcohol, but as phenomena in natural geography and climatology. The domains of astronomy expanded, particularly after the middle of the century, when analyses of the chemical composition of heavenly bodies first became possible. Meteorology also developed, perhaps not through vast improvements in the ability to predict weather, but through the extensive collection of meteorological data that would, in the long run, form the basis of such predictions. Academy members such as Göran Wahlenberg (plant geography), Anders Jonas Ångström (astrophysics) and Robert Rubenson (meteorology) contributed to this development. Human nature also started to be subject to scientific reductionism in medicine and anthropology. Here, Academy members such as Anders and Gustaf Retzius played an important role. After the rediscovery of Mendel's almost mathematical model for explaining heredity, from 1900 the Swedish researchers Herman Nilsson-Ehle and Herman Lundborg (the latter was not an Academy member) contributed to the breakthrough of reductionism in biology. This fuelled a biologistic view of mankind, the immediate consequences of which, in race biology, were catastrophic.

Reductionism has had its critics (see below), but it also laid a foundation for a tangible optimism about the ability of the natural sciences to produce solid knowledge, distinctive of the Academy of Sciences from its founding. The enlightened scientific optimism of the Age of Liberty, 1719–1772, was closely linked to expectations about the benefits of research which, subsequently, have often been described as unrealistic or naive. But perhaps here we see an example of the path dependence discussed by Björck and Kaiserfeld as regards the Academy as an institution. The rhetoric concerning the societal benefits of natural science and continual progress that was established in the 18th century has never fallen out of fashion; it has remained part of the genetic code of research.

A common theme in the history of the Academy of Sciences, from 1739 to the present day, is thus a belief in progress; in the post-war years, this also took the form of optimism regarding the ability to deal with the problems science itself contributed to creating. The 18th-century focus on the useful application of knowledge was basically conditioned by religion. There was no obvious contradiction between science and faith for people such as Linnaeus, nor between research and (within certain limits) political governance. The Academy of Sciences was, and remained, closely allied with the political and, to some extent, religious establishments during the 19th century, when it gained responsibility for a number of state-run scientific institutions. The significance of the Academy as an interface between Swedish and international science increased, due to expanded and more structured cooperation through conferences and organisations. The Academy also supported Swedish research by publishing journals and awarding prizes. During the era of the nation-state and nationalism, the Academy, like the universities, oriented itself towards the needs of the nation-state. The universities' most important role was to educate government officials; the Academy became a type of government office.

It was perceived as natural that science should make continuous, if not revolutionary, progress. This presumed development was associated with the progress of the nation, the economy and of military expansion. Reductionistic science produced a steady flow of data, the importance of which was not always immediately apparent, but which was increasingly supported by the many state-run or state-affiliated institutions being created to define and develop the nation-state. Statistics became a vital science; the rise of industrialism brought technology into ever-greater focus. The gradual expansion of higher and lower education is yet another aspect of the same trend. The circulation of knowledge is not something that occurs automatically. During the 19th century, it was carried out by the national system of greater and smaller knowledge-dependent organisations, by engineering-intensive industry, and also, in a more uncontrolled manner, by great changes to the media and communication systems – trends that would be accentuated in the 20th century.

When, in the 20th century, science came to be more regarded as a factor of production, the Academy retained its image of officialdom that had been established during the previous century and, in 1919, it was logical for the sciences associated with technology to be organised as the Academy of Engineering Sciences. This academy represented modernity and research directly linked to the needs of society and the economy. Meanwhile, the role of the Academy of Sciences as the primary body for Swedish science in the international arena was reinforced. In some regards, it came to conduct activities that were diplomatic, in a political sense, such as within the framework of the international unions in science and their parent organisation the IRC, later ICSU. The journals continued to be of importance until the 1970s, and the significance of awarding prizes only increased due to the Nobel prizes. The Academy of Sciences and the Caroline Medico-Chirurgical Institute gained a unique position as international arbiters in the fields of physics, chemistry and medicine. At a symbolic level, these pillars of Swedish science have, for more than a hundred years, also defined scientific progress on the international front.

As far as the Academy is concerned, this has hardly been taken for granted nationally. Björck and Kaiserfeld emphasise institutional inertia. In Sweden, as in most other western states, universities became the leading producers of knowledge in the 19th century. During the 20th century, academies have hardly been at the forefront of research developments, except in the former Eastern Bloc. Rather, their role has been to monitor the general interests of science, somewhat like an upper house for the scientific republic. In this sense, they have had a special role in the circulation of knowledge. Academies often publish respected journals and provide a great deal of cultural capital in the form of prizes, scholarships and, not least, membership itself, which is of course a sign of belonging to the scientific elite. They remain important bodies for international contacts and for shaping opinion. In all these contexts, academies are assumed to guarantee the quality of knowledge, and sometimes they therefore have great influence in research policy contexts (less so in Sweden than in Great Britain or the US, for example). The Swedish Academy of Sciences during the era of the Nobel Prize could be said to comprise the polished façade of research, with particular responsibility for the

Oscars gala of the knowledge society, while the universities, specialised scientific institutes and even some industries are the shop floor. The Academy certifies knowledge, but this often takes time. One often avoids that which is new and uncertain and rewards already established contributions. The Academy helps to maintain the status of scientific research, but it does it from a perception of knowledge dissemination that is tangibly elitist and *top-down*.

Since the 18th century, natural science has become an increasingly integrated part of society – from political and economic perspectives, and among the population in general. This is what we mean when we talk about a knowledge society. The striving to reduce, mathematise and systematise also meant that knowledge content became more and more abstract which, in some periods, has been held against science. The Romantics believed that abstractions and experiments made the image of nature unnatural and drained the lifeblood from science. During the age of National Romanticism in Sweden, Viktor Rydberg expressed such criticism by placing somewhat parodic and reductionist statements in the mouth of a fictional physicist, who could very well have come from Uppsala and been an Academy member:

> In the real world, the sky is not blue, the ground is not green, the sun, moon and stars do not shine, clouds do not shift through different colours, light and shadow do not chase each other across land and water, thunder does not sound, the wind does not sigh, and the words we say make no sound. [–––] The great task of natural science appears to me to be to reduce all qualities to quantities, everything phenomenal to the physical. Only then [...] can everything be subject to weighing, measurement, calculation, and become, as Pythagoras dreamed, a world of numbers, an applied mathematics.

Similar criticism recurred after World War One and perhaps contributed, as historian of science Paul Forman claimed, to creating an acceptance of quantum mechanics' criticism of the classical law of causality, among other things. That quantum mechanics enabled a less mechanistic view of nature is equally untrue as Einstein proving that everything is relative – but this strange new physics could acquire such meanings in the intellectually unconventional 1920s.

The Nazi horrors committed in the name of race biology and the development of weapons of mass destruction in World War Two had a dramatic effect on public opinion, politics and parts of the scientific community. At the same time, the years immediately following the war were characterised by a paradoxical scientific optimism, in which the progress so clearly shown by physics and engineering, in particular, was perceived as key to solving the problems that were partially due to research itself. Criticism of science reached a new height during the 1960s, now with a focus on the military use of science-based technology and on environmental destruction, two issues that have remained on the agenda since then. A common opinion in this type of criticism, which has sometimes gained strong support among researchers (for example within the Pugwash movement), has been that science's view of nature is potentially destructive because it does not take into account the greater context in which results are applied – ecological, military or social. Researchers who have chosen to support such criticism have sometimes been ostracised. One example from the Swedish Academy of Sciences is Nobel Laureate and physicist Hannes Alfvén, a critic of nuclear power.

In a famous essay, "The Whale and the Reactor", sociologist of technology Langdon Winner tried to capture modern society's paradoxical relationship with science and technology in a personal manner. Here, the whale represents free nature that has not yet become subject to human reductionism or technologisation. The reactor represents the destruction of landscape and environment that is caused by modern society's senseless consumption and unbridled scientific optimism. The reactor is an example of what Winner has called an "inherently political technology", which changes not only the landscape and the environment but also brings a need for control and security that requires repressive political measures. Winner's judgement on modern society and scientific reductionism is almost biblical:

> The excruciating subtleties of measurement and modelling mask embarrassing shortcomings in human judgement. We have become careful with numbers, callous with everything else. Our methodological rigor is becoming spiritual rigor mortis.

Winner's whale is metaphorical but also real. He did see, from a high viewpoint, a Californian grey whale outlined against the sea while observing the equally real reactor that was built in Diablo Canyon. The result was a kind of revelation about the misery of technological society. The event probably occurred in the late 1970s, shortly before the introduction of the international moratorium on commercial whale fishing, which still holds today (the decision was made in 1982 and its full implementation started in 1987). The whale that Winner used as a symbol of untamed nature was actually threatened with extinction, but since then the population has recovered and discussions are being conducted on airlifting Californian grey whales from the Pacific to the Atlantic, to increase numbers there.

Technological development began to seriously threaten the whale population in the early 20th century, including the use of harpoon guns (a Norwegian invention) and floating "factory ships" on which the whales' various parts could be processed where they were caught, in international waters and out of the reach of national law. In time, this led to international regulation, which contributed to drastic reductions in whale catches from the 1980s onwards.

Winner is right in that technology, and also science, has unavoidable political effects and implications. The Swedish Academy of Sciences has, throughout its history, worked at the intersection of politics and research – along with continuous faith in scientific progress, this is a consistent theme throughout its history. During the Age of Liberty, the Academy had wind in its sails thanks to support from the Hat regime; in the 19th century it became part of building a nation-state; during the 20th century it had research policy functions and also played an important role in scientific diplomacy. The alliance between science and politics is sometimes perceived as problematic, which it can be, in numerous ways. However, it is also unavoidable if we want to have a vibrant scientific life and sensible politics. Scientific reductionism has its drawbacks but is fundamental to research efficiency, which sometimes brings blessings. Scientific optimism is a positive force, but sometimes both naïve and dangerous. The fate of the whale has symbolised this: as a victim of the knowledge society's ruthless exploitation of resources, it may also finally be possible to save it thanks to research-based knowledge in tandem with political measures.

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On the whale that stranded in Habyfjorden, see Klaus Barthelmess & Ingvar Svanberg, "Two eighteenth-century strandings of sperm whales (Physeter macrocephalus) on the Swedish coast", *Archives of Natural History*, vol. 36:1, 2009. The Linnaeus quote is from Carl Linnaeus to Johan Mauritz Klinckowström, 22 January 1750, in *The Linnaean Correspondence* (http://linnaeus.c18.net/), L1091. See also Linnaeus to Klinckowström in the same source, 16 January 1750, L1094. The letters are dated in the "old style", i.e. the Julian calendar. According to the "new style", which has applied since 1753, they would be dated 2 February and 27 January, respectively. For the continued fate of the Linnean whale bone, see Sten Lindroth, *Kungl. Svenska vetenskapsakademiens historia 1739–1818*, I–II (Stockholm, 1967), I, 621–622; II, 471. The whale picture in Linnaeus' Hammarby is discussed in Klaus Barthelmess & Ingvar Svanberg, "Linnaeus' Whale", *Lychnos*, 2006. The quote by Viktor Rydberg is transcribed and discussed in its context in Sven Widmalm, *Det öppna laboratoriet: Uppsalafysiken och dess nätverk, 1853–1910* (Stockholm, 2001), 177. The Forman thesis regarding the new physics is advanced in Paul Forman, "Weimar Culture, Causality, and Quantum Theory: Adaptation by German Physicists and Mathematicians to a Hostile Environment", *Historical Studies in the Physical Sciences*, vol. 3, 1971. The quote by Langdon Winner is from *The Whale and the Reactor: A Search for Limits in an Age of High Technology* (Chicago, 1986), 176. For the 20th-century history of whale hunting from the perspectives of scientific and technological history, among others, see D. Graham Burnett, *The Sounding of the Whale: Science and Cetaceans in the Twentieth Century* (Chicago, 2012).