

Relationships between Academia, State and Industry in the Field of Food and Nutrition: The Norwegian Chemist Sigval Schmidt-Nielsen (1877–1956) and his Professional Roles, 1900–1950

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Abstract. The aim of this article is to shed light on the relationships between science, state and industry in the field of food and nutrition in Norway in the first half of the twentieth century with reference to the scientist Sigval Schmidt-Nielsen (1877–1956). Schmidt-Nielsen was a health authority employed state chemist at the university in the Norwegian capital and later professor of technical organic chemistry at the Norwegian Institute of Technology in Trondheim. We explore his roles, his research and his consultancy for state and industry at the university and at the institute. The early 1900s were important for the shaping of food and nutrition science as well as the growth of the food industry. During this period, food control and food regulations were implemented. Norway, the context in which Schmidt-Nielsen worked had only become an independent nation in 1905, and the state administration, as well as the university and institute were young institutions. We argue that this specific situation paved the way for the roles Schmidt-Nielsen played in academia, state and industry. By combining a biographical approach and a multi-institutional perspective, new relations between different fields within food and nutrition became visible.

Introduction

For three days in October 1909, 53 delegates from 21 countries and around 2000 participants gathered in Paris for the second international conference against fraud and adulteration in food. The participants were university professors, industry leaders and experts, and government representatives. Adulteration and fraud in food production and supply were regarded as serious problems in the age of a growing food industry in Europe. The Norwegian chemist Sigval Schmidt-Nielsen was an official delegate at this conference, and he participated in discussions and negotiations (Schmidt-Nielsen, 1910). The report he wrote after the conference marks the beginning of a process that led to the passing of the first food control legislation in the Norwegian parliament in 1933 (Elvbakken, 1997).

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Sigval Schmidt-Nielsen (Figure 1) will be the focal point of our analysis, which will consider science's involvement in academic, industry and public debates surrounding food and nutrition in Norway at the turn of the twentieth century. Early in his career, Schmidt-Nielsen was appointed chemist for the Norwegian health authorities and located at the country's only university, in the capital Kristiania, hereafter Oslo – its original name, which was reinstated in 1925.¹ Later, he served for more than three decades as professor of technical organic chemistry at the Norwegian Institute of Technology in Trondheim. The story of Schmidt-Nielsen and his relations with the authorities and with industry takes place in the first half of the 1900s. Norway was a young nation, earning its independence only in 1905. During this period, the food industry grew enormously and agriculture was changing, as was the food supply and eating habits. Although, nutrition science was only established as a scientific discipline in its own right in 1940 (Kamminga and Cunningham, 1995), during the interwar years science was increasingly used as a basis for policymaking in fields such as health policy, economics and nutrition, in Norway and internationally (Seip, 1989; Tranøy, 2011). International organizations such as the League of Nations included food and nutrition in their remit. These organizations surveyed food supply and food patterns, and provided states with advice on food and nutrition policy (Barona, 2010). Schmidt-Nielsen's experience is an example of how these ideas were put into practice at a national level. Not only did he hold positions at universities and at the Institute of Technology, Schmidt-Nielsen also performed various tasks for the authorities and for industry during the first half of the twentieth century, which means his case clearly illustrates the relations and dynamics between science, state and industry.

[Insert Figure 1 about here. Figure caption: "Sigval Schmidt-Nielsen (1877–1956), c. 1927.

Photo: Unknown/NTNU University library"]

Relationships between science and industry (the science-industry nexus) and science and the state (the science-state nexus) have long concerned historians of science and technology. Discussions on the science-industry nexus, the so-called linear model and whether science drives industry and/or the state, or vice-versa, have proliferated in recent decades (Joerges and Shinn, 2001; Grandin, Wormbs and Widmalm, 2004). In Scandinavian countries, however, it has been argued that the science-state nexus has been as important as the science-industry nexus, if not more so, and that the contract between science and society in this region is distinguished from that of other countries because of its emphasis on use and applicability (Asdal and Gradmann, 2014). Concentrating on the first decades of the 1900s, this aspect will also be illuminated in our case.

We will, however, point to some differences between the Scandinavian countries that are important in our case. Compared to Sweden and Denmark, the Norwegian state was very young. Norway was separated from Denmark in 1814, and forced into a union with Sweden later the same year, which lasted until 1905. Norway was allowed to keep the main elements of the 1814 constitution and to build a state administration while in union with Sweden, but the administration was still in its formative years in the period of our investigation. Secondly, while Uppsala University in Sweden and Copenhagen University in Denmark were founded in 1477 and 1479, respectively, the first Norwegian university – The Royal Frederick University in the capital – was founded in 1811. Thus, Norway had both a young state and a young university – and also lacked strong elites. That the 1814 constitution banned Norwegian nobility, testifies to this. The university was inspired by Humboldtian ideals, including unity between teaching and research, *Bildung* and academic freedom (Collett, 1997; Collett, 2011, pp. 135–39). Research was valued in its own right – the university aimed to not

only educate lawyers, priests and physicians. The number of professors, however, was small and many were committed to serve the authorities with advice and consultancy, for example in the field of medicine (Elvbakken and Ludvigsen, 2016). This cooperation between university and state was important at least until the 1940s, and clearly so when Schmidt-Nielsen was appointed to the university in 1907.

The young Norwegian state engaged in research and industry and research for industry. Indeed, one of the main intentions behind the establishment of state funded research institutions, such as the Norwegian research laboratory for veterinary science (Veterinærinstituttet) (Frøslie and Ødegard, 1991) and a research institute for fisheries (Havforskningsinstituttet) (Schwach, 2000) set up in 1891 and 1900, respectively, was to support research connected to the vital fields of agriculture and fisheries. During and after the First World War, crisis catalysed the state's growing involvement in securing economic and industrial development in Norway (Sejersted, 1993, pp. 139–157; Kvaal, 1997, pp. 65–96). The state established and funded scientific committees and further research laboratories. Science – on its part – was committed to contribute research which would solve the need for raw materials in times of crisis, thus also serving industry (Kvaal, 1997, pp. 65–96, 671–674). As we shall see, Schmidt-Nielsen's activities can be seen as part of such a purpose – although they go beyond crisis-driven research.

In this article, we will follow Schmidt-Nielsen and how he gained his position at the Norwegian university in Oslo and later at the new Institute of Technology in Trondheim. In this discussion we are inspired by biographical studies, which have enjoyed increased popularity in the history of science community since the mid-1990s (Shortland and Yeo, 1996; Söderqvist, 2007). Biographical-oriented studies are one way of showing relations

between different societal spheres, since a scientist is at the same time shaped by, and shapes, his surroundings (Børresen, 2004). Science is exercised by actors, and practiced in institutions with their own history, traditions, values and norms. By following one scientist over the course of a career, from one institution and discipline to the next, the many facets of a field – and the relations shaped within it, become visible.

For this article, we have drawn on Schmidt-Nielsen's publications, official documents from ministries, directorates and other public institutions, and documents from the scientist's rich private archive, including private and professional correspondence, manuscripts and lecture notes.² At the time of writing, accounts on Schmidt-Nielsen are limited to two entries in *Norsk biografisk leksikon* – Encyclopedia of Norwegian biographies (Jermstad, 1955; Trætteberg, 2009), aspects of his career related to his work at the Norwegian Institute of Technology (Lykknes and Gusland, 2015) and his role in the institutionalization of food control legislation and organization (Elvbakken, 1997). This article is, therefore, the first comprehensive narrative taking into account the different spheres within which Schmidt-Nielsen worked, for science, state and industry. Furthermore, it is the first account available in the English language.

Our narrative is organized chronologically with a focus on Schmidt-Nielsen's contributions to science, the state and industry. We will start with a short biographical sketch of his background and professional life, so as to provide an overview of the scientist's career, and point to some characteristics of his efforts for state, science and industry before digging deeper into the two main periods: Oslo 1907–1913, and Trondheim 1913–1945.

Sigval Schmidt-Nielsen (1877–1955) – engineer and academic

Sigval Schmidt-Nielsen was born in the small seventeenth century copper mining town Røros, not far from the city of Trondheim, where he grew up.³ His father was an engineer who served Norwegian fisheries from the 1880s, as secretary of the Fisheries Society in Trondheim and as curator of its fisheries museum (Danielsen, 1958, pp. 151–152), and he must have inspired the younger Schmidt-Nielsen in his choice of profession and research area. Like his brother and sister, Sigval Schmidt-Nielsen was trained as a chemical engineer at the (lower) Trondhjem Technical School (Trondhjem tekniske læreanstalt, TTL) (Bassøe, 1961, p. 446; Mølmen, 2008, pp. 58–59, 86). After completing his engineering education in 1897, Schmidt-Nielsen held short-term engagements as an assistant at the State Chemical Control Station (Statens kemiske Kontrolstation) and at the State Practical-Scientific Fisheries Survey (Statens praktisk-videnskabelige Fiskeriundersøkelser), respectively, and took up further studies within microscopy, bacteriology, microbiology and physiological chemistry, in Oslo, Stockholm, Uppsala, Copenhagen and in Germany, Belgium and Switzerland over a period of ten years. In the summer of 1900, he was an assistant at the Department of Hygiene at the university in Oslo, where he would later work. During the ten years of his educational journey, Schmidt-Nielsen visited the international fisheries exhibition in Bergen, canning and fishing industries in various countries, and participated in international and Scandinavian conferences for natural scientists. During this period he concentrated on nutritional science with an emphasis on fishery products and conservation.⁴ His doctoral dissertation at Basel in 1901 was on fermentation and fats in herrings. Fish and fats — marine fats in particular — would remain central research interests for Schmidt-Nielsen as chemist and professor in Norway. He approached these subjects, however, from the perspective of a physiologist and chemist. Schmidt-Nielsen studied both chemistry and physiology in Uppsala in 1902, under the professor of physiology, physician and rector (1901–04), Olof Hammarsten (1841–1932)

(Frängsmyr, 2010, pp. 494–495). It is plausible to assume that this cooperation with rector Hammersten will have brought Schmidt-Nielsen into contact with the core of academic life in Uppsala.

Shortly after, in 1904, Schmidt-Nielsen was appointed docent of the internationally newly established field of biochemistry (Abir-Am, 1997), at Stockholm University College (Stockholm Högskola). Over the next three years he also lectured on nutritional chemistry and physiology at the Karolinska Institute in Stockholm as well as at Uppsala University. Schmidt-Nielsen would later become an honorary doctor both at Uppsala and at Lund. In 1907, Schmidt-Nielsen married Signe T. Sturzen-Becker (1878–1959), who the same year was awarded a doctoral degree in physics from Stockholm University College. The couple would work and publish together over many years. Signe came from a family of Swedish civil servants (Wergeland, 1960) and both her father and grandfather held PhDs within language and literature (Burman, 2016). Signe, however, chose to study physics and she was in fact only the second woman in Sweden to earn a doctorate in physics (Benckert and Staberg, 1994, appendix 1). Through marriage, Schmidt-Nielsen entered into a family of civil servants and academics, and this encounter is likely to have given him insights and experiences that would become important later in his professional life.

When Schmidt-Nielsen returned to his native country in 1907, he was appointed as a so-called second amanuensis at the Department of Physiology, at the Royal Frederick University in Oslo. His main role at the university was to give lectures in physiology to science students. In a report from 1900, his acquaintance with physiology internationally as well as in Oslo is demonstrated (Schmidt-Nielsen, 1900), so the Department of Physiology was not unknown to him.

In 1908, Schmidt-Nielsen was still giving lectures in physiology, when the Ministry of Justice, which incorporated the Directorate of Medicine, employed him as a chemist (RFU AR 1908–09, p. 117). As *state chemist*, Schmidt-Nielsen was affiliated with another department at the Faculty of Medicine; the Department of Hygiene. He was already acquainted with this department as he had undertaken a summer assistantship here in 1900. Schmidt-Nielsen's new position was notable, however, because it marked the start of the scientist's lifelong engagement as an expert for the authorities, mainly serving the health authorities.

The Royal Frederick University where Schmidt-Nielsen worked was from the very beginning important for the Norwegian state and its nation building. In the field of medicine, the Department of Hygiene had particularly strong ties with the health authorities. Population statistics and surveys of causes of deaths were among the topics within the discipline of hygiene internationally, and these topics were generally of importance for state authorities (Desrosieres, 1991). Other issues addressed in the department up until the 1940s included legislative work and research (Elvbakken and Ludvigsen, 2016).

Schmidt-Nielsen's permanent affiliation with the department came to an end in January 1913 when he left the University and returned to his hometown, Trondheim, as a full professor of technical organic chemistry at the newly opened (1910) Norwegian Institute of Technology (NTH). Here Schmidt-Nielsen would establish a department and laboratories, teach, conduct research and also serve as a consultant for the state and for industry. He remained in his post as a professor at NTH until he retired at the age of 68.

As an actively publishing professor, interested in science for science's sake (Schmidt-Nielsen, 1926), Schmidt-Nielsen has been characterized as a typical *academic* among the group of professors of technology (Jermstad, 1955; Owe, 1956; Lykknes and Gusland, 2015, pp. 175–178). Schmidt-Nielsen's involvement in the Royal Norwegian Society of Sciences and Letters (hereafter the Royal Society) testifies to this. He became a member two years after he returned to Trondheim, and was one of two (out of four) chemistry professors at NTH who were members. After twenty years as an ordinary member, in 1926 he was elected Secretary General of a reorganized society; a position he held for another two decades. Schmidt-Nielsen is regarded as an important link between the old and the new society, an important contributor to the new identity of the society and a securer of continuity during his many years as Secretary General (Andersen et al., 2009, pp. 266–271).

As argued, Schmidt-Nielsen's background and the many facets of his career can be used to shed light on the overall relations between science, industry and state in the area of food and nutrition in the first half of the twentieth century in Norway.

Food and nutrition at the university and for the state, 1907–1913

Internationally, the years leading up to the First World War were important for the history of nutrition science; they are years often characterized by the search for, and discovery of, essential foods and nutrients (Kamminga and Cunningham, 1995; Carpenter, 2003). Scientists in Norway contributed to this research. The most acclaimed Norwegian research can be found in the 1907 article by the professor of hygiene at the Royal Frederick University, Axel Holst, and his assistant, Theodor Frølich, who wrote on the causes of ship beriberi (Holst and Frølich, 1907; Carpenter, 2003, pp. 982–983). The article was published in the same year as Schmidt-Nielsen joined the Faculty of Medicine.

Food and nutrition had been part of the curriculum of the Faculty of Medicine since the mid-1870s, and were topics of interest for the Departments of Physiology and of Hygiene – where Schmidt-Nielsen would later work. The Department of Hygiene concentrated on food habits and social questions, while the physiologists focused on physical chemistry and digestion. Schmidt-Nielsen's research on nutrition was mainly undertaken at the Department of Hygiene during the first two decades of the 1900s.

The Department of Physiology, where Schmidt-Nielsen was appointed as (second) amanuensis in 1907, was founded in 1875 – quite early in a Scandinavian and European context. The establishment was inspired by the growth of the discipline of physiology and its institutionalization in medical faculties in Germany from the 1860s (Kremer, 2009), where many Norwegian scientists travelled (Larsen, 2014). Equally important as a source of inspiration for Norway were the ideals of the new, experimental biology (Coleman, 1971, pp. 160–166; Kyllingstad and Rørvik, 2011, pp. 192–194; Larsen, 2014, p. 165). During the first years of the department's existence, analyses of food to find adulteration were carried out for the medical authorities at the department laboratory. The health authorities in cities such as Bergen and Oslo would publish the names of enterprises found to have offered adulterated foods for sale (Elvbakken, 1997, pp. 78–82) – a well-known strategy used by the British public health authorities at the time (Burnett, 1989).

When Schmidt-Nielsen came to the university, professor Sophus Torup (1861–1937) was head of the Department of Physiology. He had taken an interest in food and nutrition, and he contributed, among other things, to composing scientifically justified, nutrition-rich provisions for Norwegian polar explorers (Larsen, 2014, p. 174). However, Torup published

little academic work, and has been characterized as more of a teacher and lecturer than a researcher (UiO 1961, p. 155). Schmidt-Nielsen, who had already published comprehensively on nutritional chemical subjects, especially on fats, continued to pursue his interests while at the department. When he took up the position as state chemist, the laboratory activity for the health authorities was moved to the Department of Hygiene. Schmidt-Nielsen's connection to Torup's department, however, continued as he gave lectures on physiology for science students every year until he left Oslo for Trondheim. He also stayed in contact with Torup while at NTH.

During the first two years at the university, Schmidt-Nielsen gave lectures to both students of medicine and science, but thereafter his focus became the science students (RFU AR⁵ 1907–08, pp. 45, 78–79; RFU AR 1908–09, pp. 81–82; RFU AR 1909–10, pp. 91–92; RFU AR 1910–11, p. 83; RFU AR 1911–12, p. 110). Lecture notes, kept in Schmidt-Nielsen's private archive at NTNU, show that he covered physiology in general, as well as the different nutrients and their absorption and digestion.⁶

The medical discipline of hygiene was institutionalized in Norway prior to that of physiology (Elvbakken, 1995). The professorship of hygiene (also named *state medicine* or *politica medica*) was the fourth professorship to be established at the Faculty of Medicine, in 1824, which was early in a Scandinavian context (Elvbakken and Ludvigsen, 2016). The professors of hygiene came to the university from positions within the Board of Health in the capital, Oslo, and they cooperated with the health authorities; by taking part in the making of new legislation or conducting other efforts to secure public health. Internationally too, hygiene or state medicine was closely connected to the work of the local boards of health in European cities and to the health authorities in general (Rosen, 1993; Porter, 1994). Hygiene as a

scientific discipline and practice became particularly important to the young Norwegian nation-state, as infrastructural questions, city planning and legislation were among the areas taken up in this discipline.

Axel Holst (1866–1931), who was chair when Schmidt-Nielsen joined the Department of Hygiene, was appointed professor of hygiene and bacteriology in 1893. Two years later, a laboratory and a Department of Hygiene were established. The department was partly funded by the medical authorities and took on an increasing number of assignments for the government (Kyllingstad and Rørvik, 2011, p. 421). Schmidt-Nielsen's appointment in 1908 as the first government chemist was in keeping with this approach. By this time, the department was covering a broad spectrum of topics and several health authority functions were located at its premises, including that of Chief Medical Officer for Epidemics.

The Department of Hygiene must have been a fertile place for research into food and nutrition in the early 1900s. Professor Holst actively participated in the international scientific communities for hygiene, and from 1900 to 1910, the department was involved in identifying links between food and nutrients and diseases like rickets and scurvy, as well as looking for factors that could help prevent beriberi, night blindness and other diseases (Carpenter, 2003, pp. 975–984). The aforementioned article by Holst and Frølich (1907) on the causes of ship beriberi attracted international attention and was listed as one of the most important works on identifying the cause of scurvy (Carpenter, 2003, pp. 982–983).

Holst was a typical hygienist of the time: he wrote on a broad spectrum of public health issues, such as water supply, living conditions and nutrition (Elvbakken, 1995). In the 1890s, for example, he surveyed the housing and hygiene conditions of the working classes in Oslo

(Holst, 1895). With the appointment of Schmidt-Nielsen as state chemist from 1908, the relationship between the health authorities and the discipline of hygiene in Norway was further strengthened.

Earlier in this article, we referred to the 1909 Paris congress on fraud and adulteration in food. In his report Schmidt-Nielsen teems with enthusiasm regarding the importance of fighting adulteration, stating that the conference – to him – was ‘especially instructive’. He added that he had ‘a vivid impression of how, as adulterations gradually had time to spread unhindered, it will be harder and harder to take action against them’ (Schmidt-Nielsen, 1910, p. 8).

The congress allowed the representatives from industry to define what should be seen as clean products, the hygienists to evaluate the products and the chemical experts to decide on methods for laboratory analysis to prove the findings. Then, it would be up to the law experts to bring it all together. Schmidt-Nielsen argued, it was imperative that countries which did not have legislation covering food hygiene, to establish laws as soon as possible. That would ‘benefit the industry as well as the buying public’, he insisted (Schmidt-Nielsen, 1910, p. 9).

The reports written by Schmidt-Nielsen from the five years he was working for the health authorities testify to a broad hygienic perspective and show engagement in an extensive field of investigations. Many of the reports were published in the Journal of the Norwegian Medical Association (*Tidsskrift for den norske Lægeforening*, TnLf), such as his manuscript on drinking water and the hygiene requirements for the ice used for cooling (Schmidt-Nielsen, 1911, 1912). Schmidt-Nielsen’s period as state chemist might be characterized as a time when his bonds with hygiene, physiology and nutrition research were strengthened, and his experience working for the authorities – combining research and public interest in an

optimum way for both the public and the industry – was anchored. In his publications and reports the concern to promote probity in food production and trade is consistently expressed and as such brought from the scientific context into the broader arenas of state and industrial activity.

Chemistry, industry and society: Professor at NTH, 1913–1945

While the milieu into which Schmidt-Nielsen entered at the university in Oslo in 1907 had nearly one hundred years of tradition, at NTH in Trondheim each professor had to define and establish his field from scratch. Technical studies abroad – especially in Germany – became important as models, but the studies offered at NTH were also tailored to budding Norwegian industries. The professorship of technical organic chemistry at NTH, which Schmidt-Nielsen took up in 1913, was meant to cover areas such as the sugar, starch and yeast industries, nutritional chemistry and the conservation of nutrients, colourings, the fat and oil industry, destructive distillation and petroleum, and the production of organic compositions and explosives.⁷

As professor of technical organic chemistry, Schmidt-Nielsen joined three other NTH professors of chemistry who oversaw inorganic chemistry, organic chemistry and technical inorganic chemistry, respectively. When selected for the position, Schmidt-Nielsen was praised in particular for his productivity within the areas of the canning industry, physiology and hygiene and was expected to deliver results in many more sub-areas of technical organic chemistry (Teknisk ukeblad, 1912). All professors at the newly established institution were meant to achieve academically and engage in industrial projects, and for a professor in a technical field it was especially important to have, or gain, experience from industry. After Schmidt-Nielsen's time at the university in Oslo where there were two professors of

chemistry and limited laboratory facilities, the ambitions and the physical surroundings of Trondheim must have been very inspiring (Lykknes, Kvittingen and Børresen, 2005; pp. 139–144; Lykknes and Gusland, 2015, pp. 83–85). As noted, Schmidt-Nielsen would stay at his post at NTH until he retired in 1945 (figure 2). He was the only professor of technical organic chemistry in the country, and with his experience and comprehensive work for the authorities, he must have been an obvious choice when the government needed an expert in this field.

[somewhere here):

Figure 2: Schmidt-Nielsen - the professor, scientist and entrepreneur serving the state retired from his post at NTH in 1945. The photo is from 1927. Credit: Hilfling-Rasmussen/NTNU UB.

As a newly appointed professor, Schmidt-Nielsen was assigned to establish research and teaching laboratories and set up a study programme within his field; this occupied most of his time. During his tenure, he had rooms equipped for specialized research activities, and was given a research assistant to help him in his investigations. Furthermore, he gave courses on technical organic chemistry for all chemistry students, lectured on nutrients and stimulants, botany and yeast physiology for specialists in organic and nutritional chemistry, and supervised laboratory activities and annual excursions (Program, 1912–13; Lykknes and Gusland, 2015, pp. 81–127, 156, 172–175). Schmidt-Nielsen is said to have followed each student's progress carefully (Owe, 1956).

Schmidt-Nielsen's courses in technical organic and nutritional chemistry were unique in the country. The fact that nutrients were taught in chemistry in Trondheim, and in physiology for medical and science students in Oslo, indicates that nutrients and nutrition had a foot in each

field. Schmidt-Nielsen was involved in research and in the teaching of nutrition within both institutions, and can thus be regarded as a link between the scientific milieus.

Schmidt-Nielsen published extensively throughout his career. At NTH, he was one of the most productive in his department – in total he published more than 300 titles (Owe, 1956; Schmidt-Nielsen, coll. works). In fact, the chemists at the institute contributed the lion's share of all publications from NTH between 1910 and 1960 (Brandt and Nordal, 2010, p. 494), so being at the top of that list meant that he published more than most professors. Of six research grants awarded before 1925 to Schmidt-Nielsen from the institute's funds, five were on fats, of which four concerned fish fats (Lykknes and Gusland, 2015, pp. 148–149).

This interest in fish fats harked back to earlier in Schmidt-Nielsen's career and it subsequently seemed to trigger an interest in (fat-soluble) vitamins. Strong international influence and connections with fisheries and trade are reckoned to have catalysed Norwegian vitamin research (Amdam and Sogner, 1994, p. 70). Both Axel Holst at the Department of Hygiene and Schmidt-Nielsen at NTH were granted support for their vitamin research from Norwegian fisheries. The research on vitamins could serve different purposes, including mercantile ones. In 1928, a state laboratory for vitamin research (Statens vitaminlaboratorium) was established in Oslo, mainly to analyse cod liver oil in order to guarantee the vitamin D-content prior to the export of this very important product.

Of the more than thirty joint publications from Sigval and Signe Schmidt-Nielsen's hands, most were on vitamins in marine fats (Oria; Lykknes and Gusland, 2015, p. 176). In the 1920s and 1930s, the couple investigated the content of vitamins A and D (separately) in milk, marine oils, fish and shellfish, and tested rats' reactions to vitamin-rich diets after having been

deprived of one of these two vitamins first. They also studied chemical methods for the determination of vitamin content in marine fats (Schmidt-Nielsen and Schmidt-Nielsen, 1932). That their vitamin research was recognized internationally can be seen in a status report on vitamin research in the *Annual Review of Biochemistry* from 1933 (Harris, 1933), which refers to a study on the vitamin A-content in blue whale from 1930 (Schmidt-Nielsen and Schmidt-Nielsen, 1930).

In his later years, Schmidt-Nielsen published on various topics, some related to fish and fats, but he also dealt with nutrition more broadly. In 1940, he wrote a report on food consumption and food supply (Schmidt-Nielsen, 1940). In the archives, there are also many examples of texts created for public consumption. These include printed scripts for lectures given at conferences or fairs, as well as Schmidt-Nielsen's notes for radio interviews, for example when he spoke about the adulteration of food and drinks on information programmes for housewives.⁸ His knowledge of chemistry and nutrition research, and technical insight were shared as broadly as possible, and he argued for practical arrangements and efforts to promote modern methods of preserving food, and especially freezing techniques (Schmidt-Nielsen 1935, 1938).

Entrepreneur for food control legislation, 1909–1933

Schmidt-Nielsen took on various assignments while at NTH. His position as Secretary General of the Royal Society is one example. Another absorbing engagement was his long-lasting effort to establish food control legislation, which must be regarded as a continuation of his work as state chemist for the health authorities at the university in Oslo.

This work began a few years before Schmidt-Nielsen was appointed professor in Trondheim. As noted, the Paris conference on adulteration in food in 1909 encouraged scientists to work for specific food control legislation. In fact, shortly after his return from Paris, Schmidt-Nielsen contacted his superior, the Director of Medicine, Michael Holmboe (1852–1918), who then approached the Ministry of Justice to set up a committee for the preparation of legislation on food control (Elvbakken, 1997, pp. 90–141). In the work that followed, the relationships between the Oslo authorities, the Medical Directorate and the university became important. The Ministry of Justice eventually proposed a budget for the work, which the Norwegian parliament, the *Storting* accepted, and a legislation committee was appointed in 1911.

However, it took twenty-two years before the food control legislation passed the *Storting*, in 1933. Schmidt-Nielsen participated in the process during all these years. The first legislation committee had three members, including the Chief Medical Officer (*stadsfysikus*) in Oslo, Gotfried Bentzen (1852–1937), a representative from industry and Schmidt-Nielsen. After a short while, the chocolate entrepreneur Johan Throne Holst (1868–1946) became the representative for the food industry. Throne Holst was interested in science and, in particular, the science of hygiene and nutrition, and in 1932, he funded the first professorship in nutrition at the university (filled, in fact, by one of Schmidt-Nielsen's former chemistry students at NTH, the well-known physician Asbjørn Følling). Furthermore, Throne Holst is described as an advocate for a responsible and honest food industry – and a controlled, modern capitalism (Rudeng, 1989). The legislation committee as a whole thus represented competence in science and health administration, and an industrial orientation compatible with Schmidt-Nielsen's joint concern for public health and probity in food production and trade.

In 1915, the first proposal for food control legislation and specific regulations were handed over to the Ministry of Social Affairs, which had taken over the responsibility for health issues from the Ministry of Justice. The proposal was subject to a broad hearing among cities and municipalities, government and business organizations (Elvbakken, 1997). City boards of health were especially positive, arguing that the legislation would make health efforts easier and that the legislation would be important for the improvement of public health. After the hearing, some changes were made to the proposed legislation, and a new proposal was given back to the ministry in 1917. All this happened during the First World War when Norway was a neutral country, although still affected in terms of rationing and controversies over the export of fish.

The Ministry of Social Affairs did not, however, propose any food control legislation to the Storting, but instead initiated a delegation to discuss common Scandinavian food control legislation with delegates from Sweden and Denmark. Schmidt-Nielsen was a member of this delegation. A new proposal, agreed upon by the representatives from the three neighbouring countries, was put forward in 1923. The main elements were the same as those in the 1917 proposal. A new hearing was organized, and some critical comments were given. Five years later, in 1928, another committee with Schmidt-Nielsen as member carefully revised the proposal on behalf of the Ministry of Social Affairs. The Ministries of Trade and that of Agriculture were both reluctant to support a food control law, with its focus on health-oriented values. Conflicts over the implementation and value of legislation on food control continued between the Ministry of Social Affairs (later Ministry of Health and Caring) and ministries for agricultural, fishery, industry and trade issues for decades (Elvbakken and Rykkja, 2006). Conflicting views between the fields of health policy on the one hand, and the fields of agriculture, trade, industry and the fisheries on the other, were quite common in other

European countries as well, where similar legislations were discussed from 1900 onwards (Elvbakken, Rykkja and Lægreid, 2008).

After further negotiations, in which Schmidt-Nielsen represented the Ministry of Social Affairs, the three ministries came to an agreement. The committee's proposal was presented to the Storting in May 1932, but the legislation did not pass until 1933, as some specific regulations were required first. Implementation was specified for 1 July 1935. As for the formulation of the regulations, Schmidt-Nielsen was again commissioned, accompanied by experts from the Oslo Board of Health (and from the Food Control Unit), from the State Public Health Institute (Statens institutt for folkehelse), and by the Bureau Chief of the Ministry of Social Affairs. The State Public Health Institute had opened in 1929, and like other similar institutions in Scandinavia, the institute was given financial support from the Rockefeller Foundation (TfNL, 1931). This group of experts would continue to give advice to the health authorities up until the Second World War.

Why did the legislation process take more than two decades? This seems particularly strange considering that most parties supported the first proposal at the hearing in 1915. However, during the time when the Scandinavian committee was working, several comments were put forward by trade organizations: initiatives that can be regarded as attempts to postpone the adoption of the legislation (Elvbakken, 1997). These actors had resisted food control legislation since the early 1900s, as pointed out by Schmidt-Nielsen in his report from the 1909 Paris conference (Schmidt-Nielsen, 1910).

Shortly after the Scandinavian committee had finished its work in 1923, the Ministry of Agriculture proposed an alternative legislation on quality control of agricultural products.

This proposal was contested by the Ministry of Social Affairs, which feared that a quality control law, motivated by the commercial considerations of the agricultural sector, would favour mercantile interests rather than public interest related to health and probity in trade. This conflict between the mercantile and public interest has remained important up to the present (Elvbakken and Rykkja, 2006). Schmidt-Nielsen also clearly saw the legislation on quality from the Ministry of Agriculture as a competing legislation and protested against it. He argued on grounds of principle, and he maintained that the state should avoid legislation aimed at regulating relations between mercantile actors, and instead take care of public interest and public health. Despite the opposition from the Ministry of Social Affairs, however, the agricultural legislation passed the Storting and the food control legislation had to wait. This shows that the agricultural interests had strong political support (Elvbakken, 1997).

The Directorate of Health also tried to push its ministry to put forward the food control legislation. Schmidt-Nielsen's letters in the archives of the Ministry of Social Affairs from the years prior to 1933⁹ testify to an eager spokesman for the control legislation (Elvbakken, 1997, pp. 123), e.g. when Schmidt-Nielsen wrote to Bureau Chief Faanes in March 1931:

Bureau Chief Faanes! From the morning papers, I learn that a proposal to broaden the "quality-legislation", to include, among other things, the import of meat has been put forward to the Storting. The food control legislation is becoming more and more handicapped, or so it seems. Can any result soon be expected? It was very annoying that I did not get the planned conference with Minister Oftedahl.¹⁰

Schmidt-Nielsen spoke up for the legislation on radio, in newspapers and in many academic fora (e.g., Schmidt-Nielsen, 1924a). He represented continuity in the legislation committees as he stayed when other staff changed in the directorate and the ministry, and his perspectives and values remained consistent over time. Schmidt-Nielsen believed it was necessary to

regulate the production of, and trade in food in order to prevent and reveal adulteration and fraud. Regulation, in his view, would serve the double purpose of safeguarding both the public's health and probity in trade for the benefit of the citizen's of Norway and honest producers.

Three aspects stand out from the history of Schmidt-Nielsen's engagement in the legislation process. First, he initiated the new legislation after the Paris conference in 1909, and in cooperation with the Directorate of Health took part in the work from the very beginning. Second, he maintained the engagement and worked to develop the legislation as a professor in Trondheim, for twenty years. Even after the legislation had been implemented, he continued to give advice to the directorate and the ministry. In fact, his involvement continued up to 1945.¹¹ From 1939 and during the Second World War he chaired the Food Law Committee, which was established to give advice on food control issues and regulations for surrogates and other crisis-developed foods. Thirdly, and perhaps most importantly, Schmidt-Nielsen adhered to the initial values and intentions, especially the double intention for the legislation to promote both health and probity in food production and trade. He served the health authorities, always keeping health perspectives in mind. In arguing for the legislation, he spoke to housewives and industry, wrote to ministries and to newspapers, and spoke at conferences and to the public (i.e. Schmidt-Nielsen 1924a). His efforts and initiatives, perseverance and campaigning make Schmidt-Nielsen the driving force behind the Norwegian food control legislation.

State expert on fats in the 1920s

Sigval Schmidt-Nielsen, in fact, offered his expertise to the state on numerous occasions for a wide range of problems, not only to form legislation. During the years 1917–1920, Schmidt-

Nielsen was involved in solving what was described as a *fats crisis* in Norway, prompted by the First World War. Embargo and submarine warfare led to limited imports, which meant scarcity of many products. The rationing of some goods was introduced in 1914, first by locally based committees, and later by a nationwide commission. A state monopoly for trade in cereals was introduced in 1915 (Furre, 1993, pp. 59–61). Furthermore, Norway relied heavily on the export of fish and cod liver oil, which – in addition to other uses – was used for medical purposes from the 1850s onwards (Schjøtz, 2010, p. 9). Hence, questions of sea transportation and whether it was appropriate to sell cod liver oil to the warring countries became especially complicated for neutral Norway. Fats producers were therefore strongly affected (Larsen, 2012, pp. 13–28).

In 1916, a Ministry of Provisioning was established. The same year, it became clear that the country would not have enough edible fats or fats for technical use. As a response, during 1917 the Norwegian Government set up two so-called fats committees, both of which would be chaired by Schmidt-Nielsen. In the spring of 1917, the first Schmidt-Nielsen-led committee, which concentrated on the Norwegian fats industry, suggested that the state should take over trade in fats. The committee also recommended the establishment of a directorate to handle issues related to fats. A directorate was established the following year, under the Ministry of Provisioning. The fat committees reported to the Fats Directorate.¹²

The second fats committee formed in September 1917, also with Schmidt-Nielsen as chair. This committee was assigned the task of producing an edible product based on domestically accessible fats. Schmidt-Nielsen began by collecting official statistics and calculating the amount of fat needed to feed the population, and how much was available in the country.¹³ He was then able to report back his findings to the committee. One outcome of this process

was the suggestion that export commodities such as oils of marine origin, and whale oil in particular, could be hydrogenated for use in the margarine industry to such a degree that the addition of imported fats would not be necessary.

The idea of whale-fat margarine was not new. Hydrogenated whale-fat had been produced at the two most important fat factories in Norway, Denofa and Vera Fedtraffineri (hereafter Vera), and experiments with the production of whale-fat margarine had already been conducted in the country. In fact, Denofa had set up a pilot plant for the production of whale-fat margarine (Sjøborg, 1987, p. 31), and both Denofa and Vera were investigating possible uses of whale fat (Schmidt-Nielsen, 1918; Holmboe, 1937, pp. 20–24).¹⁴ Denmark and Sweden had also carried out investigations into the nutritional value of whale-fat.

Despite the interest and trials, the production of whale-fat margarine had not been authorized in 1917. It was Schmidt-Nielsen's job to lead the experiments on whale-fat production based solely on domestic raw materials, and then to issue the authorized instructions on how to prepare the hydrogenated whale-fat. Archive material shows that the margarine producers were keen for Schmidt-Nielsen to give his final approval to a process so that they could begin their own production.¹⁵ Such was the authority of the government expert on fats.

Despite its unmistakable taste – ‘to the despair of both the factories and the housewives’, according to Schmidt-Nielsen (1940, p. 79) – the margarine prepared from fats of marine origin, called the ‘national margarine’ (landsmargarin), was considered to constitute important progress and provide a vital substitute for butter in times of scarcity (Owe, 1956). At one point, a ‘state margarine’ (statsmargarin) containing a certain amount of Danish butter to improve its quality was launched, but due to high prices it was soon eclipsed by the ‘national

margarine' prepared on the basis of Schmidt-Nielsen's instructions (St. meld. 4, 1919, pp. 204–205; Schmidt-Nielsen, 1947, p. 129).

As chair of the fats committee, Schmidt-Nielsen was in charge of dividing the responsibility between Denofa and Vera, which ended in favour of one of them (Vera). The state control of fats production also meant that fat supplies from these industries were expropriated.

Eventually, the level of economic compensation to the factories had to be settled in court, and Schmidt-Nielsen, as the government representative, had – in turn – to speak against each of the two companies.¹⁶ Clearly, this must have been difficult for him, since his positions as consultant and professor at a technical institute meant that it was important for him to maintain good relations with industrial partners. However, these incidents do not seem to have obstructed Schmidt-Nielsen's collaborations. He went against the industry when he deemed it necessary, as a government representative he took on the task of standing up to the fats producers in court. Schmidt-Nielsen's efforts towards the industry can be seen in light of the state involvement in research and industry, for the benefit of public health – although not exclusively.

The role of Schmidt-Nielsen in the two fats committees should be understood from the perspective of his years of experience as an appointed state chemist, operating in cooperation with the authorities but upholding the scientific ideals of building on independent and thorough research, based on laboratory analysis and a careful discussion among peers, of findings and possible problems. Furthermore, Schmidt-Nielsen clearly showed that he knew, and took an interest in, international research in the field. We may say that Schmidt-Nielsen gave scientific legitimacy to state intervention in the fats industry.

Vitamins and canned food: Consultant for industry in the 1920s

As professor at the Norwegian Institute of Technology, Schmidt-Nielsen was well aware of the institute's desire for its staff to make contributions to both the academic scientific and industrial spheres. Each professor had, however, to find his own way to fulfil this double ambition. Among the four chemistry professors, one became an entrepreneur, two published extensively, three held patents and all acted as consultants for industry (Lykknes and Gusland, 2015, pp. 139–178). Lykknes and Gusland have argued that Schmidt-Nielsen defined his societal responsibilities as professor at a technical institute mainly as a consultant for the authorities and through extensive publishing and dissemination of information to the general public.

In Schmidt-Nielsen's opinion, science and industrial research were not to be mixed, as science was important 'for its own sake, and research for its own good' (Schmidt-Nielsen, 1926, p. 3). But, talking about these two separate lines did not mean that Schmidt-Nielsen associated himself with one of them exclusively. His role as a state expert on fats during the First World War also involved industry. In the 1920s, when plant margarine was found to be more or less devoid of vitamins, Schmidt-Nielsen was appointed as a consultant. One of his talented students, Aage W. Owe (1894–1978), a research chemist at the margarine company Mustad & Søn, introduced plant margarine with added vitamins. He needed an expert to state that this margarine was equal to butter in terms of its nutritional (vitamin) value.

Schmidt-Nielsen established a rat laboratory at the NTH, fed the rats with a vitamin-free diet, and then introduced the new margarine. It had an immediate effect on the vitamin-deprived rats, which showed that Schmidt-Nielsen's former student had succeeded in his attempts (Schmidt-Nielsen, 1924b). Again, Schmidt-Nielsen was used as an authority in his field. The

advertisement posters for Mustad's margarine even noted that, 'The vitamin content is controlled by prof. dr. S. Schmidt-Nielsen'.¹⁷ This kind of activity might be seen as linked to Schmidt-Nielsen's work on food control legislation, where he argued for the benefits of the declaration of substances contained in foods. When Schmidt-Nielsen guaranteed the vitamin content of Mustad's margarine, the company took advantage not only of his professorial competence but also of his role as a state expert: As the well-known 'Mr. Whale-fat Margarine', Schmidt-Nielsen's capacities as spokesman for the authorities, professor of technical organic chemistry and consultant for industry had merged to form the role as THE expert on edible fats in Norway, exemplifying the triangular relations between science, state and industry.

Another field, which the professor and his younger co-workers at the department investigated in the 1920s, was that of interactions between canned food and the tins used to can it. As a student, the future margarine expert Owe (1926) studied how canned goods attacked the tin and was awarded a prize for his work, while Schmidt-Nielsen, a few years later, was consulted on questions relating to the effect of aluminium in food cans.¹⁸ Problems with canned foods and possible adulteration and contamination were questions discussed during the work, which led to the passing of the food control legislation (Elvbakken, 1997, pp. 90–121). Similar problems had been discussed internationally from the late 1800s when canned food was introduced (Burnett, 1989).

Second World War-related efforts and beyond

Schmidt-Nielsen's role as expert for the state was not limited to challenges related to the First World War. In the spring of 1940, Schmidt-Nielsen published a book analysing the food supply and the consumption of food in 1938 (Schmidt-Nielsen, 1940). He pointed to potential

problems such as malnutrition and hunger, connected to the world situation and the need for self-sufficiency. The book discusses the food supply situation and the many challenges that the Norwegian population might face, and actions that would need to be taken by the authorities. Schmidt-Nielsen's experience from the fats committee, under the Ministry of Provisioning, whose main task was to handle the rationing of food and other goods during the First World War must have been valuable when working on this text. When the Second World War had begun, Schmidt-Nielsen contributed by enlightening the public about food supply planning through radio broadcasts, and by giving advice to the authorities and industries on the use of foodstuffs for new purposes (Lykknes and Gusland, 2015, p. 240).

Schmidt-Nielsen further supplied the Ministry of Provisioning with information on the preparation of glycerine, continued testing margarine samples for the margarine industry, gave advice to the Norwegian Industrial Association (Norges industriforbund) on the use of potato flour for concentrated feed or the production of bread, and the State Fisheries Research Station (Statens fiskerforsøksstasjon) on the production of pasta-like rods made from fish meat – the so-called 'fisharoni' because of their resemblance to macaroni (Lykknes and Gusland, 2015, pp. 239–240). Although 'fisharoni' production ceased in the post-war years as it was found that over time the rods developed a brown colour and were reported to have an unpleasant fish taste.¹⁹ But even though not everything Schmidt-Nielsen worked on proved to be a long-term success, it is clear that the academic, scientist and member of the Royal Society in Trondheim was widely acknowledged as the food industry's man.

The 1933 Food Control legislation did not include provisions for the administration of the legislation within the central administration. It was not until after a hearing among municipalities and industry, that the mentioned Food Law Committee was established in

1939, at which point it was given a budget from the Ministry of Social Affairs. Schmidt-Nielsen was appointed chair of this committee, and held this position until 1945. The committee would give advice on a range of questions and always seemed to consider health concerns as superior to other considerations.²⁰ One example can be found in the discussions concerning regulation for addition of colours to foods, to which Schmidt-Nielsen and the committee protested – except for the cases in which colouring was scientifically proven not to cause negative health effects. Schmidt-Nielsen once again demonstrated his integrity and adhered to his scientific ideals in his work for the state. His critical remarks were put forward to the health authorities, now under the rule of the occupation power.

Schmidt-Nielsen chose to retire in 1945, officially due to age and illness. His resignation must, however, be seen in light of his role as vice-rector during the last two years of the war – for which he was requested to account (Brandt and Nordal, 2010, p. 220). After his retirement, Schmidt-Nielsen authored a food lexicon (Schmidt-Nielsen, 1947). Over 250 pages of two-column format, the lexicon covers a wide range of entries connected to food and beverages. Clearly, he maintained an interest in food and its science, history and culture – in keeping with his professional interests over a span of more than four decades.

Concluding remarks: Schmidt-Nielsen in academia, state and industry

As chemist, engineer, civil servant and consultant, Sigval Schmidt-Nielsen's career embraced and intersected with academic science, state and industry. He was trained in Trondheim, studied and earned a doctoral degree abroad, became a member of the scientific community in Uppsala and later in Stockholm, and married a woman who held a doctoral degree in physics – quite extraordinary for that time. Schmidt-Nielsen was an academic who, when returning to Norway, came to a relatively young and small university, albeit one with a department

housing internationally recognized researchers in nutrition. He came to lecture, but he continued as researcher and acted as a scientist on behalf of the state on the international scene. As professor in Trondheim he was able to continue his scientific research and work for the state, and at the same time resume his previous interests in chemical engineering and in industry – thus closing his circle of professional interests and roles.

A biographical approach to the study of science-state-industry nexuses in Norway in the first half of the twentieth century combined with insights from studies of, on the one hand institutionalization of food control (Elvbakken, 1997), and on the other of the discipline of chemistry at the NTH (Lykknes and Gusland, 2015) have allowed us to look at institutions otherwise not closely connected in the area of food and nutrition, and at relations between fields not traditionally explored together for this particular area. This reminds us that science-state-industry relations are case-specific, and that the case of Norway is distinguished from that of other European, as well as Scandinavian countries in this particular period. The story of Schmidt-Nielsen and his roles, therefore, adds to, and helps nuance, the picture of science and its relations in the early twentieth century.

In our case we have identified four fields within food and nutrition in which Schmidt-Nielsen played an important role. In three of them he exercised authority mainly within control and regulation; his efforts to create legislation for food control and as chair of an advisory committee for implementation of the regulations (1), his efforts to form regulations for the supply of fats and establish new procedures for preparing margarine in the years of crisis prior to the 1920s (2) and his work to control the quality of industrialized margarine production in the years thereafter (3). The last field we have identified is vitamin research, to which Schmidt-Nielsen and his wife contributed articles that were cited in the international vitamin-

literature in the early 1930s (4). In this combination of activities, exercising and earning authority in forming regulations and through research Schmidt-Nielsen shaped his roles. He put his stamp on nutrition issues, research, industry and state for a long period.

For more than twenty years, Schmidt-Nielsen's worked to establish food control in the sake of public interest and he continued to give advice on these matters until 1945. His efforts in the fats committee for securing food and fats supply during the fats crisis, and for protecting against fraud is another example of his work for the state. As a part of this process, he made the chemistry laboratory at the Norwegian Institute of Technology a site for professional science-based advice to the health authorities. In some cases, such as when the compensation for fats and fats production had to be settled in court, Schmidt-Nielsen's ideals as a scientist, and his integrity as an appointed state expert could have conflicted with his needs as a professor cooperating with industry, but he nevertheless pursued them. We may say, therefore, that over the course of his career his main role was that of an entrepreneur and scientist serving the state. This exemplifies the tight bonds that existed between university, institute and state in Norway – where academics took an active part in assisting the state. By helping the fats industry, he contributed to public health, thus serving the state. Also in his role towards the industry, Schmidt-Nielsen was the entrepreneur and scientist working for the state, and by so doing he brought the realms of science, state and industry together in a melting pot.

Asdal and Gradmann (2014) argue that Scandinavia as a whole had special science-state relations, with a stress on applying science to societal issues in these countries. Based on our case, we find that this was particularly true for Norway. In the decades following the dissolution of the union with Sweden in 1905, the Norwegian state apparatus was in its

formative years. The economic situation was difficult, and before a social democratic government was formed in 1935, the country saw many governments with short ruling periods (Furre, 1993). In this specific situation the health authorities relied on advice and consultancy from experts from the university and other scientific institutions. The only Norwegian university was also relatively new and small, and many of its professors contributed their expertise and knowledge in the public interest. At the medical faculty, the Department of Hygiene had particularly close connections with the health authorities, providing advice on legislation and other regulations, and it housed experts like Schmidt-Nielsen. In Trondheim, the newly opened Institute of Technology was seen as important for building the new, independent country through contributing to science-based industrial practices. When the fats crisis arose in the early years of the First World War, Schmidt-Nielsen's combined expertise gave legitimacy to the state's decisions. We argue that these specific circumstances gave room for an actor like Schmidt-Nielsen – with his skills, background and abilities – to take on various roles within different fields of science, state matters and industry.

References

- Abir-Am, P. (1997) The Molecular Transformation of Twentieth-Century Biology, in: J. Krige and Pestre, D. (eds.) *Science in the Twentieth Century* (Amsterdam: Harwood Academic Publishers), pp. 495–524.
- Amdam, R. P. and Sogner, K. (1994) *Rik på kontraster, Nyegaard & Co – en norsk farmasøytisk industribedrift 1874–1985* (Oslo: Ad Notam Gyldendal).
- Andersen, H. W., Brenna, B., Njåstad, B. and Wale, A. (2009) *Æmula lauri. The Royal Norwegian Society of Sciences and Letters, 1760–2010* (Sagamore Beach: Science History Publications).
- Asdal, K. and Gradmann, C. (2014) Introduction: Science, Technology, Medicine—and the State: The Science-State Nexus in Scandinavia, 1850–1980, *Science in Context* 27, 177–189.
- Barona, J. (2010) *Problem of Nutrition: Experimental Science, Public Health and Economy in Europe 1914–1945* (Brussels: Peter Lang).

- Bassøe, B. (1961) *Ingeniørmatrikkelen. Norske sivilingeniører 1901–1955 med tillegg* (Oslo: Teknisk Ukeblad).
- Benckert, S. and Staberg, Else-Marie (1994) *Kvinnliga fysiker och kemister 1900–1989. Hur manga och inom vilka områden?* Kvinnovetenskapligt Forums Rapportserie, no. 5 (Umeå: Umeå Universitet, Kvinnovetenskapligt forum).
- Brandt, T. and Nordal, O. (2010) *Turbulens og tankekraft. Historien om NTNU* (Oslo: Pax).
- Burman, A. (2016) Oscar Patrick Sturzen-Becker, in: *Svenskt biografiskt lexicon*: <http://sok.riksarkivet.se/sbl/artikel/34649> (accessed October 31, 2016)
- Burnett, J. (1989) *Plenty & Want. A Social History of Diet in England from 1815 to the Present Day* (London: Methuen).
- Børresen, A. K. (2004) Johan H. L. Vogt: Naturforsker og industribygger, in: Børresen A. K. and Hård, M. (eds.) *Kunnskap og kultur: Vitenskapens roller i det norske samfunn, 1760–2000* (Trondheim: Tapir), pp. 137–174.
- Carpenter, K. (2003) A short history of nutritional science (Part 1–4), *Journal of Nutrition*, 133, 638–645; 975–984; 3023–3032; 3331–3342.
- Christ, S. E. (2003) Asbjørn Følling and the discovery of phenylketonuria, *Journal of the History of the Neurosciences*, 12(1), 44–54.
- Coleman, W. (1971) *Biology in the Nineteenth Century: Problems of Form, Function, and Transformation* (New York: John Wiley & Sons, Inc.).
- Collett, J. P. (1997) Vendepunkter i norsk universitetshistorie in: A. F. Andresen and G. Hjeltnes (eds.) *Universitet, samfunn og politikk* (Oslo: Forum for universitetshistorie, Skriftserie nr. 2), pp. 91–106.
- Collett, J. P. (2011) *Universitetet i Oslo 1811–1870: Universitetet i nasjonen* (Oslo: Unipub).
- Danielsen, R. (1958) *Trondheim bys historie: Det nye bysamfunn, 1880–1914* (Trondheim: F. Brun).
- Desrosières, A. (1991) “How to make things which hold together: social science, statistics and the state”, in P. Wagner, B. Wittrock and R. Whitley (eds.), *Discourses on Society: vol. XV*, (Dordrecht: Kluwer Academic Publishers), pp. 195–219.
- Elvbakken, K. T. (1995) *Hygiene som vitenskap, fra politikk til teknikk* (Bergen: University of Bergen, paper 35, Institutt for administrasjon- og organisasjonsvitenskap).
- Elvbakken, K. T. (1997) *Offentlig kontroll av næringsmidler, institusjonalisering, apparat og tjenestemenn*, Report 50, dr.polit.thesis (Bergen: Department of Administration and Organization Theory, University of Bergen).

- Elvbakken, K. T. and Ludvigsen, K. (2016) Medical professional practices, university disciplines and the state A case study from Norwegian hygiene and psychiatry 1800–1940, *Hygiea Internationalis*, 12(2), 7–28. DOI: 10.3384/hygiea.1403-8668.16122
- Elvbakken, K. T. and Rykkja, L. H. (2006) Norsk matkontroll – konflikter om kontrollhensyn og verdier, *Norsk statsvitenskapelig tidsskrift*, 32 (2), 119–142.
- Elvbakken, K.T., Lægreid, P. and Rykkja, L.H (2008) Regulation for Safe Food; a Comparison of Five European Countries, *Scandinavian Political Studies*, 31 (2), 125-148.
- Frängsmyr, C. (2010): Uppsala Universitet 1852-1916, Uppsala Universitet.
- Frøslie, A. and Ødegaard, Ø. (1991): Historikk, in Frøslie, A (ed): *Veterinærinstituttet 1891-1991*, Oslo: Statens veterinære laboratorietjeneste.
- Furre, B. (1993) *Norsk historie 1905–1990 Vårt hundreår* (Oslo: Det norske samlaget).
- Grandin, K., Wormbs, N. and Widmalm, S. (eds.) (2004) *The Science-Industry Nexus. History, Policy, Implications* (Sagamore Beach, MA: Science History Publications).
- Harris, L (1933) Vitamins, *Annual Review of Biochemistry*, 2, 253–298.
- Holmboe, C. F. (1937) *De-No-Fa 1912–1937* (Oslo: Denofa).
- Holst, A. (1895) An investigation of the Artizans' dwellings in Christiania, *Public Health*, 8, 372–374.
- Holst, A. and Frølich, T. (1907) Experimental studies relating to “ship-beri-beri” and scurvy. II. On the etiology of scurvy, *Journal of Hygiene* 7, 634–671.
- Jermstad, A. (1955) Sigval Schmidt-Nielsen, *Norsk biografisk leksikon*, vol. XII, pp. 467–469.
- Joerges, B. and Shinn, T. (eds.) (2001) *Instrumentation. Between Science, State and Industry* (Dordrecht: Kluwer Academic Publishers).
- Kamminga, H. and Cunningham, A. (1995) Introduction, in: Kamminga, H and Cunningham, A. (eds.) *The Science and Culture of Nutrition, 1840–1940* (Amsterdam: Cilo Medica), pp. 1–14.
- Kremer, R. J (2009) Physiology, in: Bowler, P. J. and Pickstone J. V. (eds.), *The Cambridge History of Science. Volume 6: The Modern Biological and Earth Sciences* (Cambridge: Cambridge University Press), pp. 342–366.
- Kvaal, S. (1997) Janus med tre ansikter : om organiseringen av den industrielt rettede forskningen i spennet mellom stat, vitenskap og industri i Norge, 1916-1956 (Doctoral dissertation, Department of history, NTNU).
- Kyllingstad, J. R. and Rørvik, T. R. (2011) *Universitetet i Oslo 1870–1911, Vitenskapenes universitetet* (Oslo: Unipub).

Larsen, L. Ø. H (2012) *Fett- og Oljeforsyningen under 1. verdenskrig – En analyse av statens reguleringer og Statens Fettdirektorat* (Trondheim: NTNU, Master thesis in history).

Larsen, Ø. (2014) *Doktorskole og medisinstudium – Det medisinske fakultet ved Universitetet i Oslo gjennom 200 år (1814–2014)*, (Oslo: Det norske medicinske Selskab).

Lykknes, A., Kvittingen, L and Børresen, A. K. (2005) Ellen Gleditsch: Duty and Responsibility in a Research and Teaching Career, 1916–1946, *Historical Studies in the Physical and Biological Sciences*, 36(1), 131–188.

Lykknes, A. and Gusland J. Z. (2015) *Akademi og industri. Kjemiutdanning og -forskning ved NTNU gjennom 100 år* (Bergen: Fagbokforlaget).

Mølmen, A.(2008) *Kvinnelige pionerer. En studie av 21 kvinnelige teknikere ved Trondhjem tekniske læreanstalt 1883–1915* (Master thesis in history, NTNU, 2008), pp. 58–59, 86.

Owe, A. W. (1926) Om hermetikemballagens holdbarhet: likeoverfor angrep fra den nedlagte vare, *Det Kongelige Norske Videnskabers Selskab Skrifter* 4.

Owe, A. W. (1956) Sigval Schmidt-Nielsen, Minnetale i fellesmøtet 10.12.1956, *Det kongelige norske videnskabers selskabs forhandlinger*, 29(17), 76–81.

Porter, D. (ed.) (1994): *The History of Public Health and the Modern State* (Amsterdam/Atlanta: Rodopi).

Program (1912–1913): *Program for studieåret 1912-13* (Trondheim: NTH).

Rosen, G. (1958/93) *A History of Public Health*, (Baltimore and London: Johns Hopkins University Press).

Rudeng, E. (1989) *Sjokoladekongen. Johan Throne Holst – en biografi* (Oslo: Universitetsforlaget).

Schiøtz, O. (2006) *Lofoten tran: norsk olje gjennom 1000 år: Lofoten som global tranprodusent*, Museum Nord.

Schmidt-Nielsen, S. (coll. works) [*Samlede verker*] 7 vols. (Trondheim: NTH)

Schmidt-Nielsen, S. (1900) Chemical and microbiological investigations on the curing of herring. 1. Preliminary communication. *Report on Norwegian Fishery- and Marine-Investigations* 1(8).

Schmidt-Nielsen, S. (1910) *Kongressen mod forfalskning af næringsmidler etc. i Paris: 17–24 oktober 1909* (Kristiania: Meddelelser fra Norges oplysningskontor for næringsveiene).

Schmidt-Nielsen, S (1911) meddelelser fra medisinalstyrelsens kemiker, Nr.X, Hvad skal fordres av mat-is? *Tidsskrift for den norske Lægeforening*, 1003–1007.

- Schmidt-Nielsen, S. (1912) meddelelser fra medisinalstyrelsens kemiker XIV, Hvorledes skaffes et godt drikkevand? (forts) *Tidsskrift for den norske Lægeforening*, 19, 797–808.
- Schmidt-Nielsen, S. (1918) Aktuelle opgaver for vor fettindustri. Med tillægg av S. Torup *Tidsskrift for kemi*, no. 10.
- Schmidt-Nielsen, S. (1924a) Vår føda och vår helsa, *Trondhjems Adresseavis*, 25. September.
- Schmidt-Nielsen, S. (1924b) Vitaminisering av margarin. Foredrag [paper presented] i den kemiske forening i Trondhjem 24. September 1924.
- Schmidt-Nielsen, S. (1926) Kan reagensglass anvendes ved studiet av industrielle problemer? *Svensk Papperstidning*, no. 7-8, 1.
- Schmidt-Nielsen, S. (1932) *Studentene fra 1907. Biografiske opplysninger samlet til 25-årsjubileet 1932* (Oslo, Grøndahl & søns boktrykkeri), pp. 360–362.
- Schmidt-Nielsen, S. (1935) Problemer i konserveringsindustrien, *Kungl. Landbruksakademiens Handlingar och Tidskrift* no. 4.
- Schmidt-Nielsen, S. (1938) Aktuelle konserveringsoppgaver for fiskeri og landbruk, *Dagsposten* 19–21 September.
- Schmidt-Nielsen, S. (1940) *Vårt matforbruk i 1938 og litt om vår matberging i dag* (Trondheim: Trondhjems handelskammer).
- Schmidt-Nielsen, S (1947) *Mat-leksikon, En oppslagsbok om mat- og drikkevarer* (Trondheim, Bruun).
- Schmidt-Nielsen, S. and Schmidt-Nielsen, S (1930) *Det kongelige norske videnskabers selskabs forhandlinger*, 3, 177. (quoted in *Chemical Abstracts*, 26, 1642 (1932).
- Schmidt-Nielsen, S. and Schmidt-Nielsen, S. (1932) Nogen resultater fra vårt arbeide med vitamin A og D, *Tidsskrift for den norske Lægeforening* no. 10.
- Seip, A. L. (1989) Politikens vitenskapeliggjøring. Debatten om sosialpolitikk i 1930-årene, *Nytt norsk tidsskrift* 6, 210–225.
- Sejersted, F. (1993) *Demokratisk kapitalisme* (Oslo: Universitetsforlaget).
- Shortland, M. and Yeo, R. (eds.) (1996), *Telling Lives in Science: Essays on Scientific Biography* (Cambridge: Cambridge university press).
- Sjøborg, E. R (1987) *Denofa 75 år: Tradisjon og omstilling hånd i hånd* (Fredrikstad: A/S Denofa og Lilleborg fabriker).
- St.meld. nr. 4 (1919) [white paper]: *Om Provisianeringsdepartementets og de under dette hørende direktørers virksomhet m.v. Bilag 7 Statens Fettdirektorat. Beretning om fettavdelingens virksomhet fra 1st juli til 31te desember 1918.*

Söderqvist, T. (ed.) (2007) *The History and Poetics of Scientific Biography* (Farnham: Ashgate, Series: Science, Technology and Culture, 1700–1945).

Schwach, V. (2000), *Havet, fiske og vitenskapen, Fra fiskeriundersøkelser til Havforskningsinstituttet*, (Bergen: Havforskningsinstituttet).

Teknisk ukeblad, (1912) Dr. Sigval Schmidt-Nielsen, *Teknisk Ukeblad* no. 24.

TfNL (1931): Statens institutt for folkehelse, *Tidsskrift for den norske Lægeforening*.

Tranøy, B. S. (2011) Om overflod som faglig problem ved Universitetet i Oslo” (On abundance as a problem), in: Anker, J.P., Gulbrandsen, M., Larsen, E., Løvhaug, J.W. and Tranøy, B.T. *Samtidshistoriske perspektiver*, (Oslo: Unipub), pp.173–215.

Trætteberg, M. (2009) Sigval Schmidt-Nielsen (13 February 2009) in: *Norsk biografisk leksikon*: https://nbl.snl.no/Sigval_Schmidt-Nielsen (accessed 2 February, 2016.)

UiO (1961) *Universitetet i Oslo 1911–1960* (Oslo: Universitetsforlaget), Vol. 1.

Wergeland, H. (1960) Signe Schmidt-Nielsen 1878–1959, *Det Kongelige norske Videnskabers Selskabs forhandlinger*, 33, 18, 74–78.

Notes and list of abbreviations

¹ The Royal Frederick University (Det Kongelige Fredriks universitet) was the only university in Norway until 1946. In 1939, it was renamed University of Oslo (Universitetet i Oslo).

² Sigval Schmidt-Nielsen’s private archive is number one in a series of archives relating to professors at the Norwegian Institute of Technology in Trondheim. It is held in the Norwegian University of Science and Technology (NTNU) library’s special collections, and bears the name **TEK1**.

³ Biographical information on Sigval Schmidt-Nielsen draws mainly on three sources: S. Schmidt-Nielsen’s application for professorship, 10 December 1910, PRO, NTH L0112; Schmidt-Nielsen, 1932 and Trætteberg, 2009.

⁴ S. Schmidt-Nielsen’s application for professorship, 10 December 1910, PRO, NTH L0112, folder “Vedkommende professoratet i teknisk-organisk kemi ved den tekniske høiskole”.

⁵ The printed annual reports from the Royal Frederick University give overviews of lectures, employment and publications by each of the professors and other staff members.

⁶ TEK1, Box 19, Ms 300.

⁷ P. Farup, C. N. Riiber and B. F. Halvorsen to Professorraadet, 1 December 1910, PRO, NTH L0112, folder “Utnævnelse av dr. Schmidt-Nielsen til professor i teknisk-organisk kemi ved Teknisk Høiskole”.

⁸ TEK 1, Box 20 and 21.

⁹ E.g., S. Schmidt- Nielsen to Bureau Chief Faanes at the Ministry of Social Affairs, 20 March 1930 and 3 March 1931, PRO, Ministry of Social Affairs, second Medical Office, L0342, 0001 and 0006, under the heading J: Sanitary Conditions 1862-1945.

¹⁰ S. Schmidt- Nielsen to Bureau Chief Faanes at the Ministry of Social Affairs, 3 March 1931, PRO, Ministry of Social Affairs, second Medical Office, L0342.

¹¹ TEK1 Box 25, Ms 1573 d), Box 8, Ms 245.

¹² Schmidt-Nielsen’s correspondence with the directorate, the Ministry of Social Affairs, the legislation committee and several producers and industry are found in TEK1, Box 29, e.g. folder 1 and folder 12B, Box 30, folder 13, 14, 15A and 15B.

¹³ His handwritten calculations are found in TEK 1, Box 30, Folder 14.

¹⁴ TEK1, Box 32A, Folder 22 «Vera I».

¹⁵ H. Pedersen to S. Schmidt-Nielsen, 16 November 1917; P.M. from S. Schmidt-Nielsen (undated, probably issued on 20 November 1917), TEK1, Box 30. The P.M. containing the instructions has been reproduced in its entirety in Lykknes and Gusland, 2015, p. 167.

¹⁶ TEK1, Boxes 30–33.

¹⁷ The poster is reprinted in Lykknes and Gusland, 2015, p. 175.

¹⁸ S. Schmidt-Nielsen to Norsk Aluminium Company, 7 May 1929, TEK1, Box 7, Folder “Rotteforsøk”.

¹⁹ S. Schmidt-Nielsen to A.W. Owe, 29 July 1942, TEK1, Box 25.

²⁰ TEK1, Box 5, P.M. from Schmidt-Nielsen to the food law committee, 4 April, 1942.

NTNU: Norwegian University of Science and Technology (Norges teknisk-naturvitenskapelige universitet)

Oria: Norwegian university library database, oria.no, search on Sigval Schmidt-Nielsen.

PRO, NTH L0112: Public Records Office (Riksarkivet), Ministry of Church and Education, 2. skolektr. E, Ea – Universiteter og høyskoler, Norges tekniske høiskole (NTH), L0112 – Ansettelse, poster 13, nr. 2.

RFU AR: Royal Frederick University Annual Report [year]

TEK1: NTNU University library, Special collections, TEK1, Sigval Schmidt-Nielsen.