PREPRINT 7

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Risky Rays for an Improved Food Supply?

National and Transnational Food Irradiation Research as a Cold War Recipe

Deutsches Museum

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Contents

Abstract

Die Anwendung ionisierender Strahlen als Innovation im Bereich von Ernährung und Landwirtschaft war ein Projekt des Kalten Krieges. Obwohl es gleich nach der Entdeckung der Strahlen an der Wende zum 20. Jahrhundert erste Ideen und Versuche zu ihrer Nutzbarmachung gab, entstanden die entscheidenden Realisierungsmöglichkeiten dafür erst im Kontext der im globalen Rahmen aufgeführten Systemauseinandersetzung. Das Streben der Supermächte, mit der Entwicklung friedlicher Anwendungsmöglichkeiten der Kerntechnik die Kontrolle über den Einsatz und die Verteilung von Produkten aus der Kernspaltung zu behalten, um damit strategische Vorteile im Kalten Krieg zu erlangen, forcierte deren Anwendung auch im Bereich von Ernährung und Landwirtschaft. Gleichzeitig befeuerte der Wunsch nach Zugang zu nuklearen Ressourcen und kerntechnischem Know-how Politiker, Wissenschaftler und Ingenieure in vielen Ländern diesseits und jenseits des Eisernen Vorhangs und auch in der sogenannten Dritten Welt. Sie erhofften sich sowohl internationale Anerkennung als auch interessante Arbeitsmöglichkeiten in einem prestigeträchtigen Forschungsfeld. Darüber hinaus sollte die friedliche Nutzung der Kerntechnik zur Lösung so unterschiedlicher Probleme wie der Beseitigung von Hunger und Fehlernährung in den Entwicklungsländern, der Überlebensfähigkeit im Nuklearkrieg oder der Verbesserung der Umweltbedingungen führen.

Dieser Aufsatz geht von der These aus, dass ionisierende Strahlen, die zuerst als epistemische Werkzeuge in den Experimentalsystemen der Lebenswissenschaften zum Einsatz gekommen waren, unter den spezifischen Bedingungen des Kalten Krieges vorschnell als praktische Innovationen außerhalb des Labors im Bereich von Landwirtschaft und Ernährung zur Anwendung gebracht wurden. Was zuerst aus wissenschaftlicher Neugier heraus entstand, um zu lernen, wie ionisierende Strahlen die lebende Materie beeinflussen, diente am Ende nur dem politischen Ziel, die friedliche Anwendbarkeit der Kerntechnik nachzuweisen. Projekte, wie z.B. die Lebensmittelbestrahlung, entwickelten sich zu kraftvollen Hybriden aus Wissenschaft, Technik und Politik, die die globale Verteilung von Wissen und Macht im Kalten Krieg und darüber hinaus beeinflussten. Anhand nationaler und transnationaler Programme, Projekte und Netzwerke wird diese Entwicklung für den Zeitraum vom Beginn der 1950er Jahre bis zum Beginn der 1980er Jahre untersucht.

Staging Peaceful Atoms in the Area of Cold War Agriculture and Food

Introduction

When US President Dwight D. Eisenhower announced his administration's decision to promote international collaboration for the peaceful use of the atom in front of the General Assembly of the United Nations in December of 1953, he identified agriculture as one of the potential areas of application. Research in this field, however, had already commenced half a century earlier, shortly after radioactivity was discovered. As early as the 1930s, the application of radioisotopes and radiation genetics had created attractive new areas of research in the biological sciences.[1] When the development of the atomic bomb generated a vast capacity for the production of radiation sources, it also amplified the scope of activities in the new research field of nuclear biology and agriculture.[2] Most important among the US's actions, however, was the political appreciation of nuclear science and engineering as a key technology of the Cold War. Getting access to nuclear technology fed expectations among the Cold War adversaries when it came to gaining strategic advantages in the competition between the two political blocs in order to determine which one would survive. These expectations fired the imagination of politicians, scientists and engineers in terms of ways to use the atom, thus providing access to ample research resources.[3] Eisenhower's Atoms for Peace initiative boosted the emergence of national atomic research programs in the area of food and agriculture. At the same time, Atoms for Peace helped institutionalize transnational projects, programs and initiatives to develop nuclear knowledge and techniques. Thus, a new area of knowledge production and technology transfer emerged that determined and changed the global distribution of knowledge and control in a hyper power-sensitive field.[4] What Eisenhower initiated as a project to control the development of nuclear technology and access to fissionable resources quickly grew, developing a dynamic of its own and outgrowing the originally pursued intentions of American supervision. The Atoms for Peace initiative promoted the production of new knowledge in the area of food and agriculture and at the same time fed researchers' imaginations when it came to mastering such diverse problems as how to survive a nuclear war, how to overcome hunger and malnutrition in less-developed countries, and how to reduce the dangers of increasing environmental pollution stemming from rapid economic and population growth. That these problems were to be solved with a technology that was dangerous for human beings and whose industrial

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1 For the German context see Gausemeier, *Ordnungen* 2005, pp. 195–200, pp. 220–230.

2 See Creager/Santesmases, *Radiobiology*, 2006, pp. 637–647. See also all articles in this special issue. Chadarevian, *Designs,* 2002; see also Creager, *Tracing*, 2002, pp. 367–388; Creager, *Industrialization*, 2004, pp. 141–167.

3 How politicians instrumentalized scientists' desire to get access to radioisotopes as research tools has been studied by Creager, *Radioisotopes*, 2009, pp. 219–239. One among many fields that benefited from this development was radiobiology. See, e.g., Chadarevian, *Mutations*, 2010, pp. 179–187.

4 Krige, *Atoms,* 2006, pp. 161–181; Krige, *Peaceful Atom*, 2008, pp. 5–44; Hewlett/Holl, *Atoms*, 1989.

application entailed occupational health risks from radiation exposure, however, occasionally lowered the euphoria around the peaceful atom. Still, the fear of atomic danger did not hinder but rather boosted allocation of resources in the field of nuclear research and technology. As an extraordinarily dangerous solution in search of a problem, nuclear technology developed into an explosive hybrid of science, technology and politics that decisively determined the global distribution of knowledge and control in and beyond the Cold War era. At the same time, it enormously reinforced the ties between complex organic ecological systems and large technical systems in the field of food and agriculture.

This paper argues that the inclusion of food and agriculture in the Atoms for Peace initiative served both as the most politically sellable argument for the program and as a vehicle by which a range of actors developed their own agendas during the tense Cold War decade of the 1950s and even beyond the Cold War itself. In doing so, these actors materialized the project in a soundly built national and transnational infrastructure of research and development, which gained momentum and proved resistant to several attempts to dismantle it. Focusing on these actors and the institutions they created, this paper explores how this infrastructure emerged and gained strength even though it was based on a technology whose promise – controlling the organic via radiation – was highly controversial almost from the outset (and has remained so ever since, I might add).

I will start with a survey on the emergence of national atomic programs in the area of food and agriculture in the 1950s in order to understand the various agendas and motifs of the actors involved. In the second part I will move on to the transnational level and analyse how the radiant idea of utilizing nuclear techniques for providing food materialized quickly in terms of closely connected collaborative as well as competitive transnational research networks. We will see that transnational collaboration proved to be an essential asset for the protagonists of food irradiation, who were able to overcome setbacks and discouraging difficulties at the national level through activities in regional and international spheres. These collaborations helped researchers not only to transcend the confining national frameworks of R&D but also to pull back the Iron Curtain and to capitalize on the New Ostpolitik in order to mobilize research knowledge across the divide of political blocs.

Research Notes

Whereas there are libraries stacked with literature on nuclear science and technology and its impact on the post-World War II era the application of atomic science in the life sciences, agriculture and food has only recently begun to attract the attention of historians.[5] On the

5 Creager/Santemases (s. footn. 2) surveyed the field in the life sciences. See also Creager, *Life*, 2013 (in print). Studies on the application of nuclear science and technology in agriculture and food are still scarce. For a transnational study with focus on two United Nations' special organizations as promoters of nuclear research in food and agriculture see Hamblin, *Light*, 2009, pp. 22–48. Some historical studies on food irradiation have been published. These are all national case studies, most of them on the US American case. See Hastings, *Factors*, 1995; Spiller, *Cuisine,* 2004, pp. 740–763;

one hand, this attention stems from an increasing interest in the 20th-century advancement of the biological and life sciences and, on the other hand, from the rapidly emerging Cold War studies in science and technology. Historians of science have investigated shifting boundaries between well-established disciplines and sought to understand why nuclear physicists turned to biology and carved out room for new cross border fields like biophysics and radiobiology. But historians have also looked at how biologists approached nuclear physicists for help with the development of new experimental systems. The latter consisted of new epistemic objects – model organisms that were standardized with the help of radiation – and new research methods and technologies that again were drawn from the atomic arsenal as a way to approach the new objects. Radioisotopes and radiation sources formed key technologies in these new experimental systems.[6]

Historians of science have so far explored these new radioactivity-employing experimental systems mainly from an epistemic perspective. Some of them, however, looked closer. Angela Creager, e.g., interprets experimental systems in contrast to Hans-Jörg Rheinberger, who had introduced the concept in order to develop an epistemology of experimentation, not as machines of research but as models. She argues, »the adoption of a particular experimental system as a model for investigating another object or process often provides the link between ›basic research‹ and ›real-world‹ problems.« [7] But what does the link between basic research and real-world problems imply? Creager's own research invites the conclusion that the circulation of model systems transforms such systems into new ways to handle the world, such as new medical treatments. In her studies on the application of radioisotopes as tracers and radiation sources in the biological and biomedical sciences, she explores how radioactivity-employing experimental systems had been put to use in practical applications such as, e.g., radiotherapy with reactor-produced cobalt-60 and caesium-137 teletherapy machines.[8] Hence, as we have learned from Creager, experimental systems not only produced new forms of knowing but also new ways of doing that transcended their capacity as epistemic tools and excited practitioners as innovations for medicine. This same transformation — from epistemic tool to practical innovation — occurred in the context of one of the most basic of human endeavors, agriculture and the provision of food, which is the topic of this paper.[9] The way in which experimental systems left the laboratory and the processes by which their elements –

Buchanan, *Meal*, 2005, pp. 221–249. For the Soviet case see Josephson, *Atom*, 2000, Chapter 5: pp. 146–166. A political science study compares food irradiation in Germany and France but only as case studies for national differences in regulation politics, see Meins, *Politics,* 2003. A study on a failed irradiation project in West Germany was conducted by Zachmann, *Fish,* 2012, pp. 179–194. For a transnational study on food irradiation and »nuclear agriculture« see Zachmann, *Atoms*, 2011, pp. 65–90, and Zachmann, *Machbarkeit*, 2011, pp. 231–253.

6 On the concept of experimental systems see Rheinberger, *History*, 1997. For a critical review see Laubichler/Creager, *Deconstruction*, 1999, pp. 129–142.

7 Creager, *Paradigms*, 2012.

8 Creager, *Life*, Chapter 9.

9 Helen Curry explores an important part of the application of atomic science in agriculture – the use of radiation genetics in breeding – in her dissertation. Curry, *Evolution*, 2012.

standardized organisms and research technologies such as ionizing radiation – encountered the world beyond the laboratory are questions that invite further research.

Cold War studies in the history of science and technology were highly focused on all matters nuclear from the outset. This is because, in their dual meaning as dreadful military technologies and dreamlike but dangerous civil technologies, nuclear technologies became a major site of the international Cold War balance of power. Thus, they are inseparably bound up with politics. Therefore, if historians want to learn more about the politics of artefacts and technologies of power, all matters nuclear are inevitably among the first objects of study. For a long while, however, these studies focused on power reactors and successive generations of nuclear weapons and the systems used to deliver them. Only recently have historians moved on to study the application of nuclear science and technology in medicine, agriculture, and food.

The Technological Base of Food Irradiation[10]

Food irradiation uses the energy of ionizing rays to preserve food. It works either by destroying micro-organisms and insects that are responsible for the spoilage and damage of organic matter or by decelerating the ripening or sprouting of fruits and vegetables. Food irradiation is also used to kill parasites in meat products that cause food-borne diseases. X-ray machines, electrostatic accelerators for producing electron beams, and reactor-produced isotopes such as cobalt-60 or caesium-137 – the latter two emitting gamma rays – were and still are used as radiation sources. Most effective but also most dangerous are gamma rays. They penetrate the irradiated items most deeply, but the isotopes that produce them cannot be switched on and off: therefore gamma-ray sources require costly containment and monitoring facilities. Electron accelerators provide a continuous throughput with the food items placed on conveyor belts, but they are the most expensive machines and difficult to construct. X-ray machines are readily available, but only X-ray tubes that can produce high doses are suitable for food irradiation. Even then, owing to the inherent spectrum of radiation produced by X-ray tubes, products treated with X-rays receive a much higher dose of radiation on their surfaces than within the products.[11] Today, food irradiation centers are predominantly equipped with gamma-sources.[12]

10 The following paragraph is an extended version of the section on food irradiation technology in Zachmann, *Atoms*, 2011, pp. 66–68.

11 The first comprehensive descriptions of the process and the technology of food irradiation appeared in the early 1950s in the US and in Great Britain, see Proctor/Goldblith, *Radiation Fundamentals*, 1951, pp. 119–196, and Hannan, *Problems*, 1955. The first German textbook on food irradiation was Kuprianoff/Lang, *Strahlenkonservierung*, 1960.

12 See Food Irradiation Treatment Facilities Database 2012, available at http://nucleus.iaea.org/fitf/FacilityDisplay.aspx, accessed January 19, 2013.

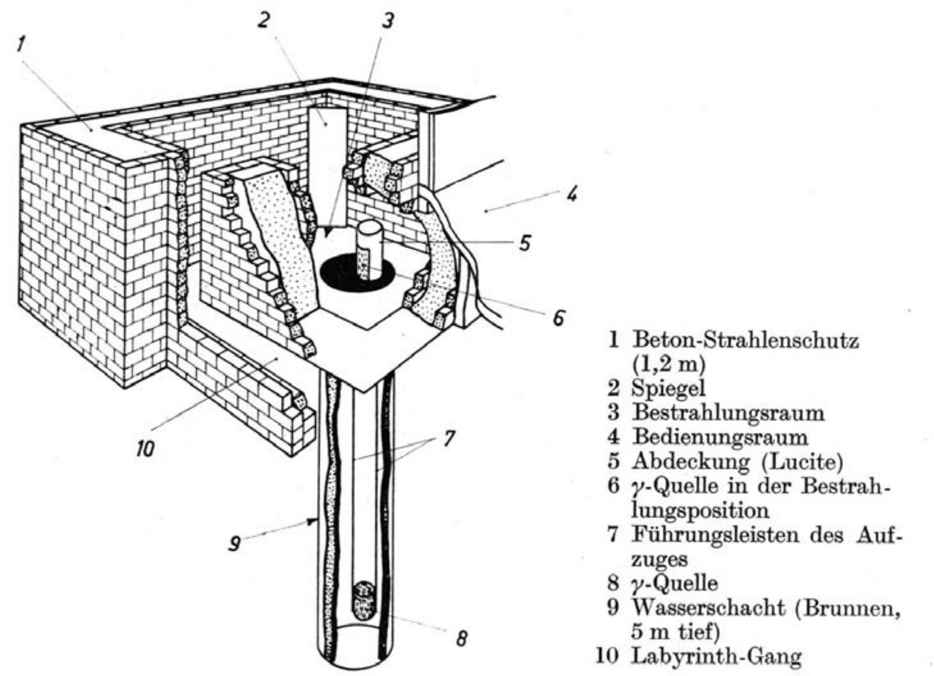

Figure 1: Irradiation facility with a cobalt-60 source lowerable in a well shaft for containment. This test arrangement was used at Michigan University, Ann Arbor, Michigan, USA.

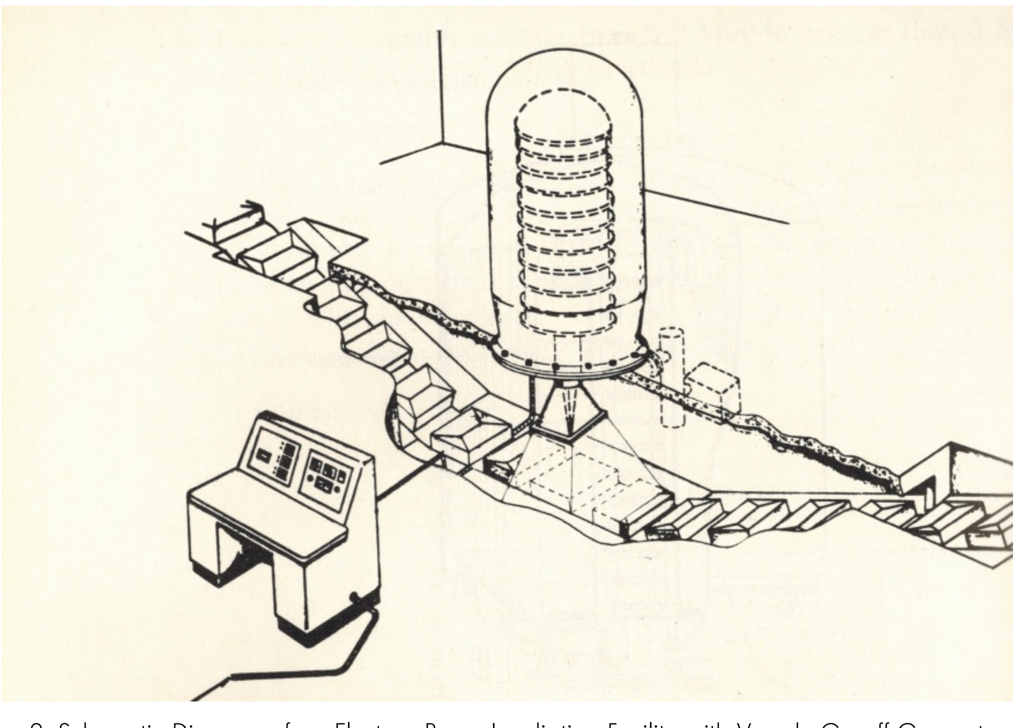

Figure 2: Schematic Diagram of an Electron Beam Irradiation Facility with Van-de-Graaff-Generator. The food runs through the electron beam on conveyor belts.

Shortly after the discoveries of X-Rays and radioactivity, first suggestions for irradiating foods came up. In 1896 Friedrich Minck, a German doctor, published a study on the effects of X-rays on bacteria.[13] In the interwar period the effects of radiation and radioactivity on living structures advanced to an intensely investigated field at the borderline of biology, physics and chemistry.[14] First patents on the use of ionizing radiation for the preservation of foods and for killing food-born bacteria were taken out in 1905 and again in 1918 and 1930.[15] Soon, entrepreneurs tried to commercialize radioactivity by adding radium to foods and health products. A German chocolate factory sold chocolate bars containing radium as a »rejuvenator«. St. Joachimsthal bakeries provided radium pastries that contained minute quantities of radium. Another bakery of the Bohemian town with the richest radium resources in Europe advertised bread that was produced with radium water.[16] Radium enhanced products were also sold as means for the »sexual rejuvenation« of men. One of these products was Radithor, a 1920s radium tonic that contained more than 74 Bq of radium per bottle. A wealthy steel manufacturer from Pittsburgh, who was a well-known sportsman and playboy, became one of the first victims of Radithor; he died of radium poisoning in 1932.[17] Out of this first phase of interest and curiosity in the effects of ionizing radiation on foods, however, no systematic research developed.

Figure 3: Radithor was a radium tonic that was sold as a sexual rejuvenator on the US market in the 1920s.

13 Minck, *Frage*, 1896, pp. 101–102.
14 Jahn et al., *Geschichte*, 1982, pp. 472, 505.
15 A British Patent No. 1609 was issued to Appleby and Banks in 1905. They described the effect of the radioactive noble gas Radon that emitted alpha rays as providing quality improvement for food. In 1918 a US American patent was issued to D.C. Gillet for protecting his invention of a commercial X-Ray application for destroying insects in foods. In 1930 Otto Wüst received a French patent on the use of X-rays for killing bacteria in foods. None of these patents was carried into commercial production because there were no efficient irradiation sources available. On the early history of food irradiation see Goldblith, *Development*, 1966, pp. 3–17.
16 Rentetzi, *Trafficking*, 2008, Chapter 1.
17 Frame, Paul: Radioactive Curative Devices and Spas, Oak Ridge Newspaper, 5 November 1989, available at http://www.orau.org/PTP/articlesstories/quackstory.htm, accessed February 5, 2013.

Two of the most famous innovations in warfare that provided the decisive preconditions for sustained research and development on – and eventual commercialization of – food irradiation were radar and atomic weapons. Radar's development gave rise to powerful klystron tubes, improved wave guide techniques, and electronic circuits and components, which made available machines capable of generating ionizing radiation of a power hitherto unachieved. The innovation of the atomic bomb resulted in a vast capacity for the production of cobalt-60 and other sources of ionizing gamma radiation.[18] The Manhattan Project not only gave birth to the first atomic bomb but also to systematic research interest in the irradiation of food. This interest was at first stimulated by efforts to protect workers and bomb constructors from the hazards of radioactivity.[19] But the research agenda was soon extended when in 1952 the US Atomic Energy Commission (AEC) as legal heir of the Manhattan Project set up a program to explore the possibilities of using reactor produced radioisotopes as radiation sources to sterilize food and pharmaceuticals.[20] Thus, the Manhattan Project paved the way for the development of radiation preserved foods, even though food irradiation did not entirely depend on knowledge, technology and needs that emerged from the atomic bomb project. But the bomb's very existence was of critical importance for the rapidly increasing efforts to put irradiated foods on the tables in the US and elsewhere.

Envisioning Atomic Food for Peace and War in National Food Irradiation Programs in the 1950s

USA

US food irradiation research began as wartime military research not only in the immediate context of the Manhattan Project. The MIT food technologist Bernard Proctor launched work with sterilization of meats when he directed a large food research program at the Institute for the Office of the Quartermaster General in World War II. Proctor's first radiation source was a big air-insulated Van de Graaf at MIT.[21] The researchers continued with the meat sterilization project after the war. In 1945, food technology became a department in its own right at MIT and this separation from the biology department was accompanied by a reorientation toward the physical sciences in research and teaching.[22] The department closely collaborated with the MIT departments of physics, electrical

18 Siu, *United States Program*, 1963, pp. 19–26.

19 Hacker, *Tail*, 1987. This concern and related activities survived the war since the effects of nuclear radiation on food products and packaging became a subject of exploration in nuclear test explosions. Operation Teapot conducted at the Nevada test site from February through May 1955 was one of these test series that explored the effects of radiation on food. Documents are available after registration at the DTIC website on operation teaport http://www.dtic.mil/docs/citations/ADA995308, accessed February 5, 2013. I am most thankful to Alex Wellerstein who brought these documents to my attention. On Operation Teapot see Hacker, *Elements*, 1994, pp. 164–169.

20 The Contribution … Hearings, 1954, p. 78.

21 Goldblith, *Microbes*, 1995, p. 192.

22 Buchanan, *Meal*, 2005, p. 231.

engineering and nuclear science. And Proctor attracted a whole range of industrial sponsors such as can companies, meat packers, gristmills and many others who exhibited great interest in the work on »cold sterilization« and disinfestation of food with ionizing rays. But also the Army and the AEC financed this research. In 1952 the department obtained a self-contained cobalt-60 gamma ray source.[23]

1952 was the year when the AEC began to support research on food and pharmaceutical sterilization by setting up a program for the utilization of fission by-products and making cobalt-60 sources available to several institutions.[24] The AEC contracted four universities to conduct this research. Besides MIT also the University of Michigan participated in the program and acquired a large 3000 Curie gamma source.[25] But shortly thereafter the US Army Quartermaster Corps entered the atomic kitchen and took over the AEC contracts. In 1953, the year that Eisenhower delivered his famous Atoms for Peace speech in front of the United Nations' General assembly, the US Army set up a comprehensive research program on preserving food with ionizing energy. It intended to improve military logistics for an upcoming nuclear war when traditional supply chains would be highly vulnerable to contamination. The sergeant majors of the US Army Quartermaster Corps intended to control and successfully manage a nuclear catastrophe with radiation-preserved foods with an extremely long shelf life and no need of refrigeration. The Quartermaster Corps expected to work with 10 to 15 contracted universities. Arrangements were made with the National Reactor Testing Station in Idaho for irradiating foodstuff at its material testing reactor with fuel elements as gamma source.[26]

According to estimates of participants in the US Army food irradiation program, the military spent some 25 to 30 million dollars over a time span of 10 years between 1953 and 1963 and a total sum of 51 million dollars up to 1977 on developing atomic food.[27] The army collaborated with a whole range of actors from research institutions within the military, the university sector, and electrical and engineering companies to leading firms in the food industry. Until the end of the 1950s it conducted research in both low dose as well as high dose food irradiation, worked with human test subjects, and set out to design a large-scale pilot plant with a 2.5-Megacurie Cobalt-60 source and a 24-Megavolt Linear Electron Accelerator in Stockton, CA (in the heart of that state's vast agricultural system). The pilot plant was designed to develop production techniques for irradiating foods and to produce sufficient quantities of atomic foods to test their acceptability for both the military and the civilian markets. However, the construction project, which had already been started, was halted near the end of the 1950s when the US Food and Drug Administration passed stringent approval regulations for irradiated foods.

23 Goldblith, *Microbes*, 1995, p. 207.
24 The Contribution … Hearings, 1954, p. 78, and Goldblith, *Development*, 1966, pp. 3–17.
25 The Contribution … Hearings, 1954, p. 78.
26 Ibid., pp. 81–82.
27 Siu, *United States Program*, 1963, pp. 19–21. Comptroller General of the United States, The Department of the Army's Food Irradiation Program, Is it worth continuing?. September 29, 1978, i, available at http://archive.gao.gov/f1002a/107349.pdf, accessed February 5, 2013.

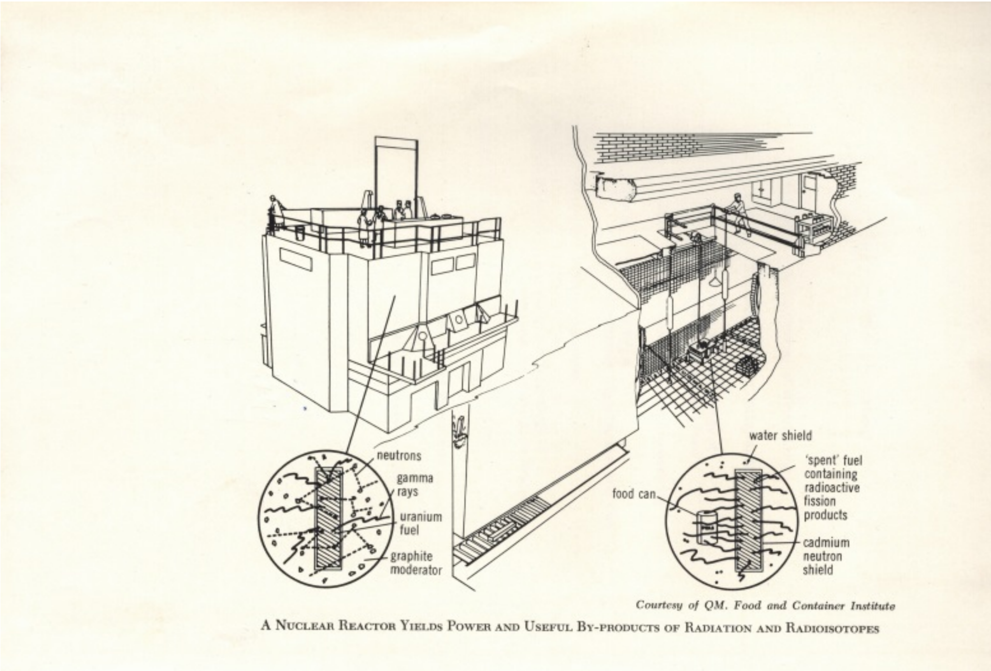

Figure 4: Gamma Irradiation Facility with »spent« fuel elements from a nearby reactor. In 1953 the US Army Quartermaster Corps arranged with the National Reactor Testing Station in Idaho for irradiating foodstuff at its material testing reactor with »spent« fuel elements as gamma source.

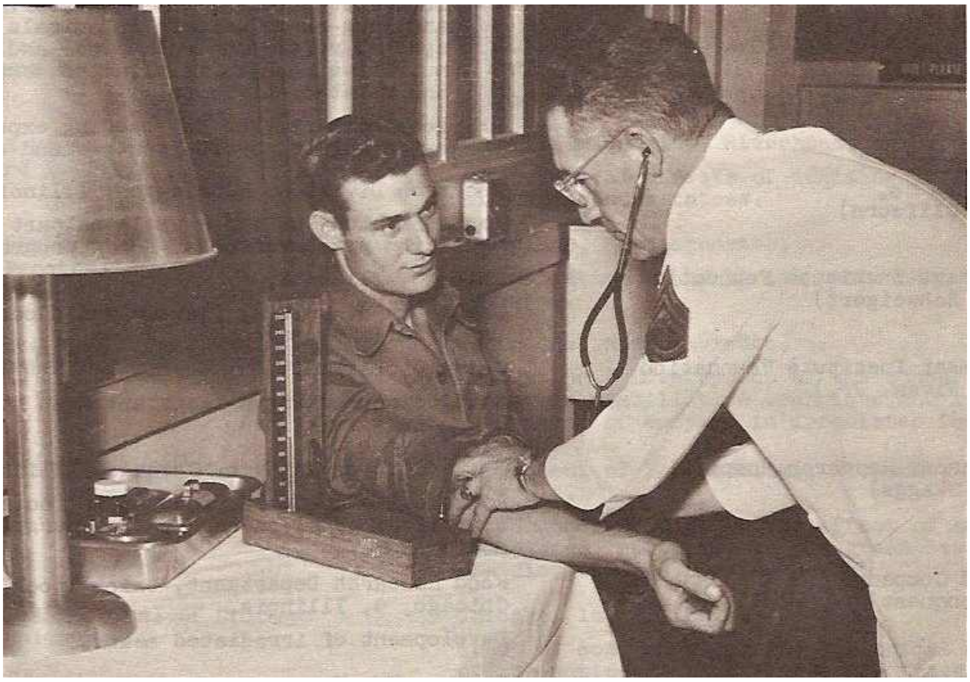

Figure 5: Medical examination of a volunteer consumer of gamma-irradiated food at US Army Medical Nutrition Laboratory, Denver, Colorado.

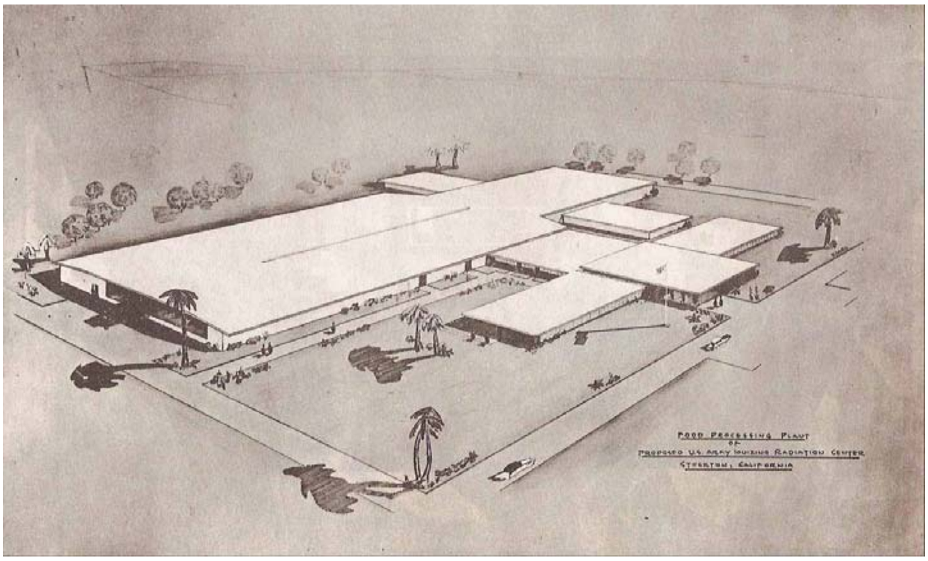

Figure 6: US Army Food Irradiation Pilot Plant Project, Stockton, CA. The pilot plant project was halted near the end of the 1950s.

The Food Additives Amendment of 1958 to the Federal Food, Drug, and Cosmetic Act included sources of radiation in its definition of a food additive. Based on this inclusion, it mandated the following regulation: »A food shall be deemed to be adulterated […] if it has been intentionally subjected to radiation, unless the use of the radiation was in conformity with a regulation or exemption in effect pursuant to section 348 of this title.«[28] After stating that »a food additive shall […] be deemed to be unsafe«, section 348 specified the conditions for exemptions and established procedures for petitions to establish safety.[29] It was the so-called Delaney Clause that established a »zero cancer risk« standard for processed foods that was translated into the language of the law with the Food Additives Amendment. The Delaney Clause referred specifically to chemical additives and especially pesticide residues in processed foods.[30] The extension of the Food Additives Amendment to radiated foods, however, translated the increasing nuclear fear of the late 1950s, for all intents and purposes, into a ban against irradiated foods and thus tempered the US Army's hopes of quickly introducing atomic military rations. Consequently, the Army cut down on irradiation research and subsequently focused on high-dose research for meat sterilization, whereas the AEC assumed responsibility for low-dose research, which was seen as potentially valuable for civilian uses, such as destroying salmonella in poultry and preserving fruits and vegetables.[31]

28 21 U.S.C., United States Code, 2010 Edition, Title 21: Food and Drugs, Chapter 9, Federal Food, Drug, and Cosmetic Act, Subcharacter IV, Food, Sec. 342 –Adulterated food, available at http://www.gpo.gov/fdsys/pkg/USCODE-2010-title21/html/USCODE-2010-title21-chap9-subchapIV-sec342.htm, accessed February 5, 2013.

29 Ibid., Sec. 348. See also Josephson, *Procedures*, 1966, p. 883.

30 Vogt, *Food*, 1995, pp. 1–19.

31 Revised Army Program on Food Preservation by Ionizing Energy. Approved: 11 March 1960, Department of the Army. Office of the Quartermaster General Washington 25, D.C, available at

Western Europe

But this indigestion of the atomic hype during the late 1950s that became palpable in US Food and Drug Administration's (FDA) nearly prohibitive food regulations did not keep European food irradiation projects from gaining speed. Before we start asking why this was true, however, we need to know when European countries entered this field of research and development.[32] In Europe efforts to initiate food irradiation research were closely connected to the availability of reactor facilities. Great Britain, France, and Norway were the first countries in Western Europe with reactor facilities that went critical in the late 1940s and early 1950s. All three countries were early movers in research on food preservation with ionizing energy.

Norway began exploring the possibilities of preserving fish by irradiation in 1948 and 1949 followed by a project on vegetable and fruits in 1953, which was located at the Nuclear Physical Institute of the Agricultural College at Vollebekk within the framework of a more comprehensive program on the application of atomic science in agriculture and foods.

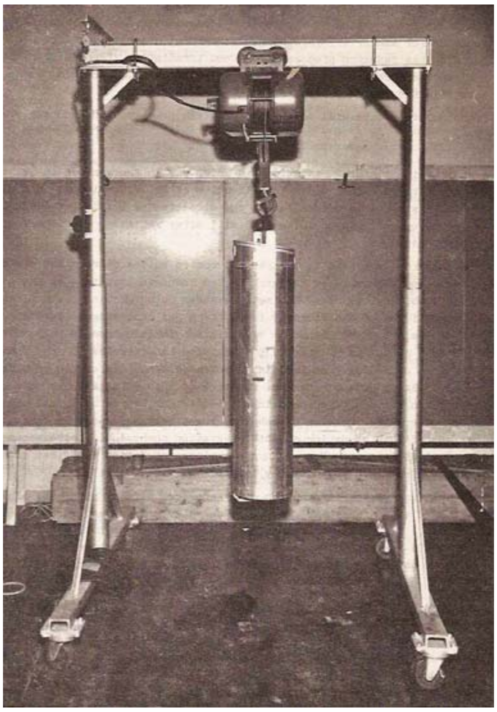

Figure 7: Equipment for irradiation of potatoes, fruits and vegetables in a channel outside the graphite layer in the reactor at Kjeller, Norway. The container was lowered by winch into the reactor to the most convenient position.

https://www.osti.gov/opennet/servlets/purl/1047748/1047748.pdf, accessed January 20, 2013, and Comptroller General of the United States 1978, p. 5, see footn. 27.

32 For information on the beginnings of national food irradiation programs in Europe see the report by Desrosier, who was the Director of the Food Radiation Preservation Division at the Quartermaster Food and Container Institute for the Armed Forces in Chicago and worked as a consultant for the European Productivity Agency (EPA), Desrosier, *Food*, 1959, pp. 102–149.

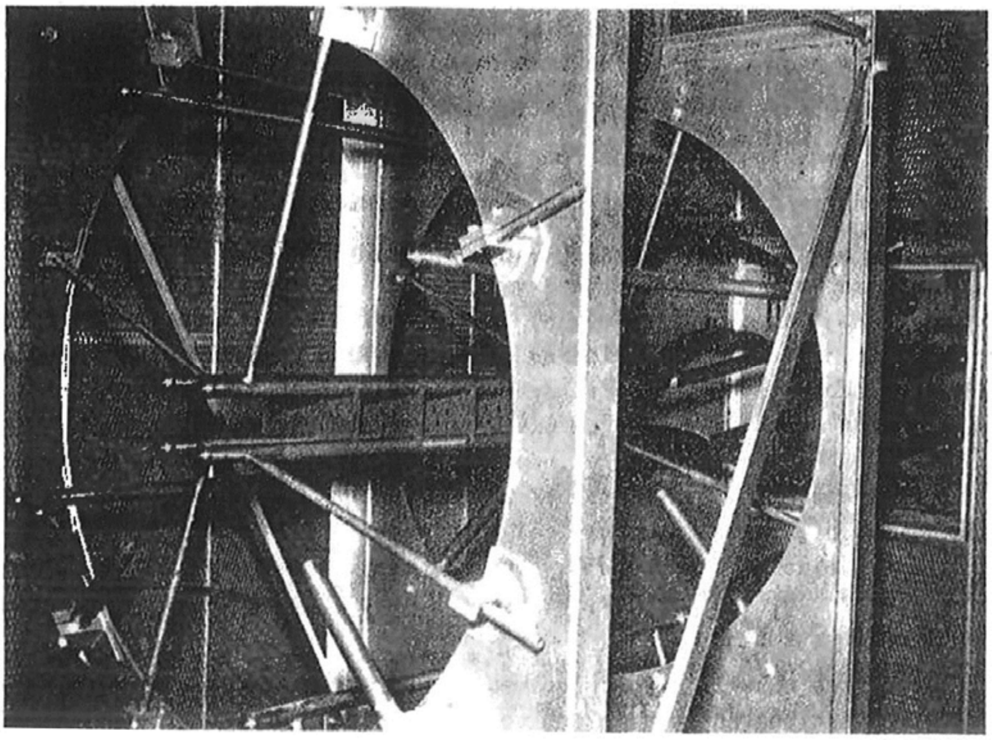

Figure 8: Five thousand curie radiation chamber at the Wantage Research Laboratory of the UK Atomic Energy Research Establishment in Harwell. The four source tubes can be moved anywhere between the center and rim of the jug, to accommodate different shapes and sizes of objects to be irradiated.

The British claimed a pioneering role in European food irradiation research, which was undertaken in two places: the Low Temperature Research Station in Cambridge and the Wantage Research Laboratories of the Atomic Energy Research Establishment in Harwell. Hannan and his co-workers began publishing research results and summaries as early as 1950 and several symposia were held on the subject as well. Industry participated in this research, too, as is evidenced by publications from the Research Department of Metropolitan-Vickers Electrical Co. and financial support from Metal Box Company Limited and Mullard Research Laboratories, Salsford. The British food establishment took an interest as well. The British Food Manufacturing Industries Research Association and the British Baking Industries Research Association studied the preservation of packaged foods with ionizing radiation. Thus, governmental research institutions in both atomic energy research and low-temperature research as well as the industrial R&D departments of equipment producers and food manufacturers and their respective industry cooperative research organizations established the British framework for food irradiation.

In France the French Atomic Energy Commission (Commissariat à l'énergie atomique – CEA) established three nuclear research centres between 1945 and 1956. The most important one at Saclay did research on industrial applications of atomic energy with a strong focus on food irradiation beginning in 1951. Its Director, Dr. Pierre Levêque, became a well-known figure on the transnational stage of food irradiation. His department offered radiation services to industry, governmental, and university laboratories, as well as training courses. Furthermore, France developed a unique privately owned company for R&D in food irradiation with the telling name »Conservatome«. [33] It acted as a clearing-house for 22 co-operating firms throughout France, which represented the various commodity groups, and had its own research laboratories and staff. Conservatome was supported by the CEA, which held a 34 per cent share for several years. The corporation was located in Lyon and managed by Pierre Vidal, who, after becoming well known in the refrigeration business, then extended his activities to atomic energy applications. He launched the Centre Lyonnaise d'Applications Atomique as a general private research center, which also included food preservation laboratories and the world's first industrial cobalt-60 facility. A third group of researchers worked at universities in Lyon and Paris. The French food irradiation lobby eagerly tried to establish themselves as the European headquarters for research on atomic food, as, of course, did the British.

A second group of countries consisted of Belgium, Denmark, and the Netherlands, each of which acquired their own reactor facilities in 1956 and 1957 but had strong research traditions in nuclear physics. These countries developed ambitious research programs on nuclear techniques in food and agriculture in the mid-1950s. In Belgium the Nuclear Energy Study Center at Mol set up a department for food irradiation studies and provided radiation services and expertise including training courses for scientific and technical staff for a whole range of subsequently emerging university and governmental institutes in Belgium and in neighbouring states. When in 1957 the newly founded European Nuclear Energy Agency decided to establish the Eurochemic Company plant for reprocessing of irradiated fuel at Mol, protagonists of food irradiation proposed to add a food irradiation pilot plant. The US consultant and Director of the Food Radiation Preservation Division at the Quartermaster Food and Container Institute for the Armed Forces in Chicago, Norman W. Desrosier, envisioned the Mol pilot plant as a promising complement to the pilot plant project of the US Army in Stockton, California; the experiences gained from both pilot plants would enable food processors in OEEC countries »to formulate plans for the integration of radio-stabilised foods into the current channels of food distribution.«[34] While Eurochemic began to reprocess irradiated fuels by the early 1960s, the plans for the food irradiation pilot plant never materialized.[35]

33 On Conservatome see Meins, *Politics*, 2003, pp. 75–76, and pp. 83–84.
34 Desrosier, *Food*, 1959, p. 148.
35 On the history of Eurochemic see Wolff, *Eurochemic*, 1996.

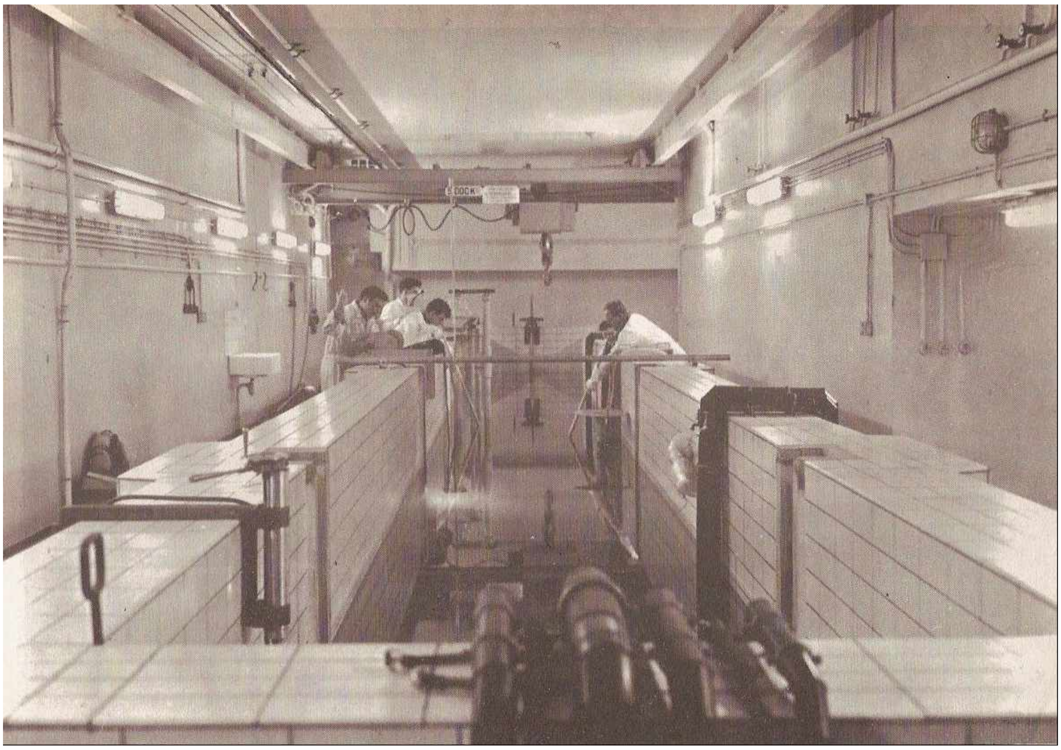

Figure 9: Irradiation canal containing spent fuel elements from the reactor at the Nuclear Energy Study Center at Mol, Belgium.

In 1957, as part of the Atoms for Peace activities, the Netherlands' government decided to establish an Institute for the Application of Atomic Energy in Agriculture (ITAL) in Wageningen.[36] The government also resolved to equip the institute with a Biological Agrarian Reactor of the Netherlands (BARN). The reactor went critical on 9 April 1963.[37] Before its reactor went critical, the Dutch program depended on radiation service for the treatment of food provided by the Belgian reactor station in Mol. Industry there also took interest. The Philips Laboratories in Eindhoven investigated the use of high-energy electrons in the sterilization of foods. The Dutch atomic establishment eagerly encouraged co-operative research in food irradiation among governmental, industrial, and university laboratories.

36 In April 1961 ITAL signed a 20 years' collaboration contract with Euratom that got the latter to finance two thirds of the institute's costs and the reactor. In October 1964 the institute was officially reopened as Euratom-ITAL, van den Berg, *ITAL*, 2002, p. 34; Zoek ITAL Wageningen at kernenergie-innederland, available at http://www.kernenergieinnederland.nl, accessed February 23, 2013.

37 Desrosier, *Food*, 1959, p. 139; Bundesarchiv (BA) Koblenz, B 116, Folder 15503, Das Biologie-programm von Euratom 1961–1964, Bericht und Ausblick von R.K. Appleyard, pp. 41–42; van den Berg, *ITAL*, 2002, pp. 7–8, 34.

Figure 10: Reactor Building of ITAL Wageningen in October 1964. This building contained the Biological Agrarian Reactor of the Netherlands (BARN), the first and only reactor in the world that was devoted to research in food and agriculture. The reactor went critical in April 1963. It was shut down in 1980.

Denmark introduced its first research program in the early 1950s and used the irradiation service provided by a German company, the Leybold Corporation of Cologne, before setting up its own radiation facilities. The Danish Atomic Energy Commission erected its general research facilities, directed by Niels Bohr, in Riso. There, the first Danish reactor went critical in 1957. Denmark, which had a well-developed cold chain with the most advanced food locker system in Europe, studied irradiation in connection with refrigeration instead of as an alternative to it.

A third group of European countries launched food irradiation research in the second half of the 1950s in close connection with the erection of their own radiation facilities. Switzerland conducted research on ionizing radiation at two centres: the Roentgen Institute in Bern and the Battelle Memorial Institute in Geneva. The long-standing Swiss food industry pushed this new branch of food research. Nestlé's research laboratories and the R&D department of the Knorr Food Products Company engaged in radiation research on sterilization and the use of radiation as a processing tool.

In 1959, Italy, Greece, and Portugal put their own radiation facilities into operation. All three countries became vitally interested in food irradiation. In Italy the most explicit programs had been established by the end of the 1950s. University and governmental research institutes in the field of agriculture and food were involved, as well as the associations of meat processors and fruit and vegetable processors. In Italy, the national productivity agency – a structure that was an outcome of the American productivity mission and the »basement« for the European productivity mission so to speak – established a committee for coordinating activities in the field of food irradiation. Furthermore, Italy was the only European country that stressed the importance of food irradiation as a means of modernizing its food distribution system from the start. An association that bore the same name as the French »Conservatome« was organized to explore the potential of atomic food in the economics of food distribution.

Austria erected its Nuclear Research Centre in Seibersdorf near Vienna with a reactor that went critical in 1960. The Seibersdorf centre gained additional resources and influence from the fact that the IAEA headquarters in Vienna decided to establish a permanent research laboratory in Seibersdorf. Whereas the Austrians were late in setting up an atoms program for food and agriculture, the Seibersdorf laboratory launched the first international project for studying the irradiation of fruit and fruit juice, which lasted from 1965 to 1968.[38]

Among the countries of this third group was West Germany. Here the efforts to develop nuclear research in agriculture and food took off rather suddenly in 1955. Only when the German Federal Republic regained its national sovereignty in 1955 was it entitled to have access to nuclear resources.[39] In that year a ministry for nuclear technology was established, headed by future Bavarian prime minister Franz-Josef Strauß, who was assigned to coordinate West German nuclear activities in close collaboration with ministers of other governmental departments. Selecting the fields of interest was one of their first tasks. In November 1955 the Federal Ministry of Food, Agriculture and Forests (FMFAF) launched a survey in order to learn about atomic research and application interests within its realm.[40] On November 27, 1955, FMFAF announced plans to establish a council for peaceful atomic research and suggested that the heads of the main governmental food-related research institutes be appointed to it. Four months later, in March 1956, the minister publicly announced topics for nuclear research in food and agriculture.[41] These were: radiation genetics regarding pathological and practical effects in microorganisms, plants and animals; plant physiological and soil problems in agriculture, horticulture and forests; plant pathology and pest control; animal physiology and feeding with regard to the effects on animal products (meat, eggs, milk and fish); animal pathology including hygiene and therapy; and, finally, food preservation with further attention to packaging and food radiation protection. One and a half years later, on August 31, 1957, the Minister for Nutrition, Agriculture and Forestry set up a nuclear

38 Fischer, *History*, 1997, p. 379; Desrosier, *Food*, 1959, p. 123, 126; Historical Archives of the EU in Florence, OEEC–NUC (OEEC 1095–Film), NE/IR(62)1, Paris 10.4.1962; NE/IR(62)2, Paris, 19.6.1962; Complement to Progress of Food Irradiation Work 1968, 1969, pp. 2–3.

39 Eckert, *Anfänge*, 1989, pp. 115–143; Radkau, *Aufstieg*, 1983.

40 BA Koblenz, B 116, 15502, Vermerk über Besprechung am 10.11.1955 vom 15.11.1955 von Ministerialrat Dr. Trost.

41 BA Koblenz, B 116, 15502, Minister an alle Direktoren der Bundesforschungsanstalten und einschlägige Universitätsinstitute am 21.3.1956: Aufgabenstellung der Atomforschung im Bereich der Landbauwissenschaften, der Ernährungswissenschaft und der angewandten Biologie.

research program in the ministry and assigned concrete research tasks to specific institutes.[42]

The Ministry of Food and Agriculture's atoms program revealed the West German government to be the main promoter and actor in research and development of atomic food. Subsequently the ministry assigned two of its research institutes as centres of the atoms program in food and agriculture. These were the Federal Research Institute for Food Preservation in Karlsruhe for all studies on food irradiation, packaging, and radiation protection and the Federal Research Institute for Agriculture in Brunswick-Völkenrode for all studies on the application of atomic science in agriculture.[43]

The institute in Karlsruhe became the dominant German research centre on food irradiation. The institute was founded as a research institute for refrigeration technology at the Karlsruhe Technical university in 1926, only to be upgraded to a federal institute for food preservation 10 years later. At that time refrigeration technology and deep freezing became a strategically important technology in the food politics of the Nazi state as it aimed for food autarky and improved food logistics for the battlefields of World War II.[44] The institute's Director, Johann Kuprianoff, was the leading figure who developed and represented food irradiation studies in West Germany in the 1950s and 1960s. Trained as a refrigeration engineer, he followed his teacher and leading German refrigeration engineer, Rudolf Plank, in the position as Director of the Karlsruhe institute in 1948.[45] Thus, as in Great Britain, France, Denmark, and some other European countries, refrigeration engineering and low-temperature research acted as a midwife for food irradiation in West Germany, too. In contrast to the US, where the frozen food establishment watched the emerging hype on food irradiation fearfully as a threat to their own business[46], in

42 BA Koblenz, B 116, 15502, Das atomare Forschungsprogramm des Bundesministeriums für Ernährung, Landwirtschaft u. Forsten, Bonn, 31.8.1957.

43 Ibid., p. 1.

44 Plank, *Festschrift*, 1936; Heiß, *Einrichtungen*, 1936, pp. 140–144.

45 Diehl, *Kuprianoff*, 1971, p. 277.

46 In the US the cold chain was already well established, and business with frozen food had started to blossom. Thus, the first statements about food irradiation as a new preservation technology caused irritation among the frozen food establishment. The editor of the leading trade journal, Quick Frozen Food, stated in the journal's Forum in the June 1955 issue: »Recently a somewhat misguided enthusiast of nuclear energy stated there would be no need for refrigeration in five years because irradiated food would then be abundant. Similar statements have led to some apprehension on the part of freezers and canners as to the solidity of their methods of food preservation.« (Williams, *Food*, 1955, p. 41). Williams hastened to calm his readers as he stressed the unresolved safety problem of irradiated foods and the enormous costs of the process. The worries, however, were significant enough to cause the frozen food industry to conduct a survey of the perspectives of food irradiation among universities, manufacturers, government agencies, and researchers. The results were published under the heading »Irradiated Foods coming … Threat to Frozen Foods Many Years Away!« by Taylor, *Foods*, 1955, pp. 43–49. Taylor drew as the main conclusion of this survey that by 1960 the first irradiated food items might appear in shops but that it would still be several more years before irradiated food became »a competitive threat to the freezing and canning industries« (ibid., p. 43). Four years later, however, the frozen food experts gave the all clear. In an article entitled »Irradiation Blister Bursts«, in Quick Frozen Food 22 (1959), p. 11, 44, the journal reported on the cancellation of the Army's pilot plant project in Stockton and the termination of irradiation

Western European countries the refrigeration experts themselves happily moved into the new field and helped establish it.[47] Food irradiation promised the availability of new resources as well as more prestigious positions. Introducing nuclear physics into the field of food processing could – so it was hoped – extend the radiance of a highly prestigious undertaking to the as rather traditionally regarded field of food technology because of its militarily important high technology. Kuprianoff published the first – and internationally well received – textbook on food irradiation and innumerable articles on the subject during his tenure at the institute.[48] Furthermore, he sat as the German representative in many national and international commissions. In 1961 he was appointed to the newly established chair for the technology of food processing at the Technical University Karlsruhe.[49]

Figure 11: Johann Kuprianoff (1904-1971), who was trained as a refrigeration engineer, was the leading figure of the German food irradiation program from the mid-1950s to the end of the 1960s.

experiments by frozen food packers like Campbell Soup, Minute Maid, Swift, Thomas Lipton and National Biscuit. The experts stated with relief that albeit food irradiation research would continue, it would take more than 20 years now before food irradiation could become a threat (ibid., p. 44).

47 The frozen food industries of most Western European countries, which were generally not as advanced as that of the United States, experienced a ten-year downswing after World War II. The only exception to this development was the UK, see Thevenot, *History*, 1979, pp. 265–267; Hilck/Hövel, *Null*, 1979, pp. 45–46, 50–52. Thus, frozen food experts in Europe seemingly saw food irradiation rather as an opportunity than as a threat for their own business.

48 Kuprianoff/Lang, *Strahlenkonservierung*, 1960.

49 Before his appointment Kuprianoff had already been teaching as honorary professor at the Technical University Karlsruhe since 1948. He was the leading figure behind the inauguration of the German-wide first study course for general food engineers who were trained for all branches in the food business and designated as a subgroup of mechanical engineers instead of chemical engineers. Kuprianoff, *Ausbildung*, 1954, pp. 155–162; Diehl, *Kuprianoff*, 1971, p. 277.

As Director of the Karlsruhe institute Kuprianoff worked busily on its expansion by adding a new research laboratory for the application of radiation on food. Publicly he legitimized the need for research on food irradiation, first, as a chance to develop a new food preservation technology for temperature-sensitive foods and, second, also as a way to use nuclear waste.[50] The justification of food irradiation as a way to use nuclear power effectively by employing used fuel rods was not yet driven by environmental concerns as it would be in the 1980s[51] but was rather a positive statement for nuclear power in the emerging debate on its costs and effectiveness.[52] Different arguments, however, were used in internal communication. In a classified letter to the Minister of Finance from October 30, 1957, the food and agriculture colleagues justified the new laboratory for food irradiation by invoking the probability of a nuclear war, referring to a post-Sputnik decision by the NATO council that all civil emergency planning had to assume nuclear war. The national storage of food for a »modern« war, the food and agriculture ministry argued, would need science to explore possibilities of long-lasting preservation as well as the effect of radioactive fallout on food and, finally, for the protection of agriculture and food in a nuclear war.[53]

The new Karlsruhe laboratory was constructed in the second half of 1958. First plans to build a laboratory for radiation physics dated back to 1954.[54] At the July 1958 OEEC conference on the application of atomic science in agriculture and food in Paris, Norman Desrosier, the Director of the Food Radiation Preservation Division at the Quartermaster Food and Container Institute for the Armed Forces in Chicago, named the Karlsruhe institute »one of the best equipped research institutes for the irradiation of foods in the world« in his survey on the US-American and OEEC programs and resources for food irradiation.[55] The Karlsruhe irradiation laboratory possessed three strong radiation sources, two X-ray machines from German firms, and a Van de Graaff electron accelerator imported from the High Voltage Engineering Corporation in Burlington, Massachusetts.

50 BA Koblenz, B 142, 490, Vortrag Kuprianoffs auf der Tagung des Verbandes Deutscher Landwirtschaftlicher Untersuchungs- und Forschungsanstalten am 17.9.1957 in Heidelberg.

51 For the US see Hastings, *Factors*, 1995, pp. 198–214. Here the Department of Energy pushed for the use of caesium-137 in food irradiation until 1988, when it became clear that caesium was an unsafe source material.

52 The first Geneva Conference on the peaceful use of the atom was driven by an enormous euphoria about the promise of nuclear power. Soon thereafter, though, a more restrained optimism developed. It came to a stop completely at the second Geneva Conference in 1958 when the prospects for the competitiveness of nuclear power were postponed for many years. Radkau, *Aufstieg*, 1983, pp. 89–90.

53 BA Koblenz, B 116, 32398, An den Bundesminister für Finanzen, Schnellbrief Bonn 30.10.1957. On 23 May 1957 the North Atlantic Council approved the report by the Military Committee MC 48/2. The report contained measures to implement the strategic concept of a nuclear war. Final decision on MC 48/2. A Report by the Military Committee on Measures to implement the strategic concept, 23 May 1957, available at http://www.nato.int/docu/stratdoc/eng/a570523b.pdf, accessed February 5, 2013.

54 BA Koblenz, B 116, 15502, Atomare Forschung im Bereich des Bundesministeriums für Landwirtschaft, Bonn, 13.5.1954, III B 4, 3809.11.

55 Desrosier, *Food*, 1959, p. 145.

Furthermore, Karlsruhe planned to acquire a multi-kilo curie Co-60 source for irradiating thicker food samples with gamma rays, as well as a high-performance linear accelerator. In 1959, when the long-planned Karlsruhe National Atomic Energy Establishment finally materialized, Kuprianoff's institute won a major victory with the decision to place food irradiation laboratories on this campus.[56] The new building, however, did not open until 1966, the same year an international conference on food irradiation was held in Karlsruhe.[57] Nevertheless, Kuprianoff and his institute remained among the main actors on the international stage of food irradiation.

What have we learned so far from surveying the emergent national food irradiation programs in the West in the 1950s? It was clearly the US that strongly invited its European partners to an atomic meal via its Atoms for Peace campaign. Most amazingly, this invitation was neither discussed nor rejected by the partners electorate, although the European participants knew that the US program for food irradiation had been openly promoted, financed and conducted by the US army since 1953. To pursue food irradiation for improving military food logistics in a nuclear war obviously did not hamper the image of atomic food as a symbol of the peaceful atom.

In Europe the endeavour to develop atomic food was attractive to national governments because it justified the claim to gain access to nuclear resources. Because access to nuclear resources in turn proved to be a symbol for national sovereignty as the Cold War unfolded in the 1950s, this eagerness becomes understandable.[58] Furthermore, many more actors followed their own agendas by engaging in food irradiation. The militaries of the European states were interested for obvious reasons but did not act as openly as in the US, because they could transfer this task to European governments and their respective ministries. Governmental research institutes in the fields of agriculture and food, as well as co-operating university departments happily tackled the new field as collaboration in what at that time was the most prestigious area of science, that of nuclear physics, and promised access to more resources, enhanced reputations, and rewarding expert positions in international institutions. Evidence for access to more resources can be found, for example, in the newly established institutes for food processing technology that were elevated from being appendages of existing organizations or university departments to becoming independent university institutes or stand-alone research institutes. These organizational opportunities stemmed from nuclear physic's powerful promise of new applications in biology and thus also in the fields of agriculture, nutrition, and food science.[59]

56 BA Koblenz, B 116, 32398, Vermerk 16.5.1959 BFA, Errichtung Institut für Strahlenanwendung.
57 Goldblith, *Development*, 1966, p. 14.
58 For the best study conducted so far on the relationship between nuclear technology and national sovereignty, see Hecht, *Radiance*, 1998. For Britain see Gowing/Arnold, *Independence*, 1974. For Germany see Radkau, *Aufstieg*, 1983.
59 This institution building occurred roughly simultaneously in the Netherlands, France, and Germany, among other European nations, and was preceded slightly earlier in England and the United States, for obvious reasons. In Germany the Technical University Karlsruhe established a

Industries got excited as well. Equipment producers were interested because radiation technology promised to open new market opportunities. The food industry and even food retailers proved curious as they looked for new methods of food processing and food distribution. The promise for extending the shelf life of perishables was one of the main pros for food irradiation voiced by the food establishment. Governments also ranked the expected advantages of atomic food for the modernization of food distribution systems as very high on their list of pros for the new technology.

So, we see the three main pillars of national innovation systems – governments and their militaries, university research, and industry – involved in research and development up to first application tests of atomic food. In all countries, however, it was almost exclusively the state that financed the beginnings of food irradiation R&D, regardless of whether the money was spent by national atomic energy commissions, the military, or several ministries that poured resources into their research facilities or university institutes. There are a few exceptions, however. Industrial establishments took a more active part in some countries; these were mainly firms in the food business that had corporate research and development departments, and equipment producers, like the British Metropolitan-Vickers Electrical Company or the Dutch-based Philips Corporation, the latter of which used high-energy electrons in the sterilisation of foods in their laboratories in Eindhoven.[60] The ways, however, in which private business participated in the preparation of atomic food differed widely. In some cases, companies employed their own staff in research and development departments (Nestlé, Knorr, Philips, and others). In other industries research facilities of trade associations got busy with food irradiation R&D (e.g., British Food Manufacturing Industries Research Association, British Baking Industries Research Associations, and others).[61] A specific structure emerged in France where a privately established but partly state financed company (Conservatome) was set up to coordinate and facilitate research and development for irradiation in various industries but mostly in the food business.[62]

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course for food technology at the department of mechanical engineering in 1949. One of the subjects that were to be taught was biophysics. The initiators of the new course (Rudolf Plank and Johann Kuprianoff) hoped to get advice from Boris Rajewski, the Director of the Kaiser Wilhelm Institute for Biophysics, for appointing a lecturer (Universitätsarchiv Karlsruhe, 21001, Sig. 340). Since the mid-1920s one of Rajewski's main research interests had been the effects of radiation on living beings. In 1960, shortly after Kuprianoff's project to build a new laboratory for radiation physics for food irradiation at the site of the nuclear research centre Karlsruhe was funded, he was appointed as chair and head of the institute for food technology at the Technical University Karlsruhe. This was the first chair with this designation in Karlsruhe (Universitätsarchiv Karlsruhe, 28102, Sig.11, Kuprianoff an den Bildungs- und Kulturminister, 28.9.1960). The case of the Netherlands involves the country's Agricultural University Wageningen (s. footn. 106, 107). Subsequent research on the transnational institutions and their research projects will allow me to document these developments more fully and to show in what ways they shared common origins and in what ways their patterns of growth differed.

60 Desrosier, *Food*, 1959, p. 139, 144.

61 Ibid., pp. 138–139, 144–145.

62 Meins, *Politics*, 2003, p. 84.

Short Excursion to Eastern Europe

Also on the Eastern side of the Iron Curtain political chefs eagerly strove to put atomic food on the Communist menu. Already in the early 1950s researchers of the Soviet Academy of Science and several institutes elsewhere in the Soviet Union were exploring the potential of food irradiation and other applications of nuclear techniques in biology, agriculture, and food processing. Driven by the desire to win the next Cold War battle in the field of science and engineering after the successful launch of Sputnik, the USSR became the first country in the world »to clear irradiated foods for human consumption when it approved the sale of irradiated potatoes in March 1958«.[63] A year later this approval was followed by the approval of the irradiation of grain to eliminate insect infestation.[64] It was several years, however, until irradiation facilities went into operation. By the end of 1961 scientists at the A.N. Bakh Biochemistry Institute in Moscow had designed the world's first full-fledged irradiation pilot plant for industrial-scale experiments with potatoes. It commenced operation in 1964, followed by a second one shortly thereafter. Because of high costs, however, Soviet officials decided not to pursue a larger program.[65] In contrast to the abandoned potato program, irradiation technology to prevent grain infestation became a big success. But it was 24 years until an elevator-based radiator with a capacity of 400,000 tons per year began operation in the Odessa port.[66] But having been the first nation to approve food irradiation did not bring with it the same level of success at the Cold War battlefront as the launch of a Sputnik or putting a man on the Moon.

Other socialist bloc countries started entering the atomic kitchen in the mid-1960s. Based on a report from a COMECON expert meeting in October 1965, it is clear that at that time only the Soviet Union and Hungary were conducting larger food irradiation research programs. GDR sources, however, reveal that food scientists closely followed activities in the fields of nuclear agriculture both in the Soviet Union and the West. Prof. Joseph Herrmann (1912-2005), who headed the Institute of Technology and Stockpiling at the faculty of agriculture and horticulture at the Berlin Humboldt-University, published articles on food irradiation in GDR journals from 1957 onwards.[67] He soon specialized on the question of potato irradiation. It was, however, only in the 1980s that the GDR began irradiating onions, whereas East German potatoes were never commercially treated with ionizing rays.[68]

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63 Josephson, *Red Atom*, 2005, p. 151.
64 Diehl, *Safety*, 1995, p. 348.
65 Josephson, *Red Atom*, 2005, p. 153.
66 Diehl, *Safety*, 1995, p. 325.
67 See, e.g., his first article: Herrmann, *Anwendung*, 1957, no. 2, pp. 56–59 and no.3, pp. 82–87.
68 Luther/Böttcher, *Einfluss*, 1991, pp. 136–152. The GDR ran four irradiation facilities in the following places: Weideroda in Thuringia, Spickendorf and Schönebeck in Saxony-Anhalt and Radeberg in Saxony. Ibid., p. 151. Besides onions the GDR irradiated enzymes for breweries, chicken carcasses and spices. Göbel, *Beispiele*, 2005, pp. 185–206. The investigation on East-European food irradiation programs is still a work in progress.

Figure 12: Marketing Test with Irradiated Potatoes in Budapest, Hungary 1973. The Hungarian Food Research Institute in Budapest intensively studied food irradiation. József Farkas, the Vice Director of the institute from 1959–1986, has been a member of many transnational projects and networks.

Transnational Institutions and Uses of Nuclear Methods in Food and Agriculture

Atomic food was not only being prepared on a national but also on a transnational level. From as early as the mid-1950s, when the first Geneva Atoms for Peace Conference boosted internationalism in nuclear research, food irradiation became a subject for transnational collaboration. A whole range of already-existing or newly-created institutions, like the Food and Agriculture Organization of the United Nations (FAO), the International Atomic Energy Agency (IAEA), the World Health Organization (WHO), and (at the European level) the European Productivity Agency of the Organization of the European Economic Community OEEC (EPA), the European Nuclear Energy Agency (ENEA) and Euratom, promoted atomic food as an important item on the menu of transnational politics. In 1969, physicists, biologists, agricultural experts and engineers established a political cross-bloc European Society for Nuclear Methods in Agriculture (ESNA) that claimed both to improve the world food situation and to limit environmental pollution. All transnational organizations established programs, expert committees, and working or study groups in order to facilitate international co-operation. The underlying motives for these activities were manifold. They differed among the actors involved, and they changed over time. Let's take a closer look at how this transnational framework of food irradiation emerged. In doing so I hope to disclose the framework's structure, the actors' intentions, and the contribution of atomic food R&D in shaping the Cold War world.

Occupying Space – The FAO Prepares for the First Geneva Conference

When international delegates to the first Geneva Conference convened in August 1955, they envisaged the atom yielding a modern, abundant cornucopia. Already, the atom's application in food and agriculture was but one major factor behind this radiant perspective. At the conference, papers delivered on the application of nuclear radiation in food and agriculture totalled 85 (47 of US origin), thus indicating an increasing interest in atomic food.[69] In the ten years after the explosions at Hiroshima and Nagasaki revealed the devastating effects of nuclear radiation on living beings and their food supplies, scientists were busy exploring these effects. At the Geneva Conference, many of these same scientists presented their findings as contributions to peaceful use of the atom.

FAO representative Ronald A. Silow (1908–1990) and M. E. Jefferson from the United States Department of Agriculture were responsible for generally outlining the relationships between the atom, agriculture, food, and peace.[70] This collaboration between the two men revealed two things. It staged the FAO as a head chef in the atomic kitchen but also put a US Department of Agriculture (USDA) representative in charge of the menu. What this meant becomes clear from a closer look at the preparations that went into this collaboration.

FAO involvement with atomic food began only a few months prior to the Geneva Conference. The latter was one of two pillars for promoting Eisenhower's Atoms for Peace initiative that he announced in front of the United Nations General Assembly on December 8, 1953. It was seen as a demonstration of the willingness of the US to share its knowledge and experience of atomic science and technology with all other nations. The other pillar was the establishment of a new atomic energy agency as an institution for promoting and, in this way, controlling research, development and use of nuclear technology. It took the Eisenhower administration and its diplomats nine months before they were able to announce that six other nations – Australia, Belgium, Canada, France, South Africa and the United Kingdom – had agreed to form an international agency to promote atomic energy for peaceful purposes. These seven nations then drew up a »Resolution on International Cooperation in Developing Peaceful Uses of Atomic Energy« that the General Assembly of the United Nations adopted at its 503rd plenary meeting on December 4, 1954. The UN resolution asked the UN specialized agencies explicitly to play an effective part, not in setting up the new agency but in planning the proposed conference.[71]

69 Singleton, *Radiation*, 1958, pp. 361–365.
70 The paper was first published as P/780 of session 7.2 (Agriculture) with the title »The uses of atomic energy and agriculture« under the authorship of FAO in the Proceedings, 1956, pp. 10–18. Singleton republished it in Singleton, *Nuclear Radiation*, 1958, pp. 27–44, under the title »The Atom and the World Food Problem« and Ronald Silow and M. E. Jefferson were mentioned as authors.
71 FAO Archives Rome, 10 TAC 344, Box 3 of 4, United Nations, General Assembly resolution 810 (IX) International Cooperation in Developing the Peaceful Uses of the Atom. Fischer, *History*, 1997, p. 23.

The FAO acted immediately. On December 23, 1954, its Acting Director General established an Inter-Divisional Working Party on the Uses of Atomic Energy in Agriculture and assigned to it the task of making recommendations on the role of the FAO in the Geneva Conference and on possible provisions in the program of work for 1955 and 1956.[72] British plant geneticist Ronald A. Silow was appointed chair of this group. Silow had earned his academic reputation in cotton research and joined the FAO in 1952.[73] One of his first actions was to contact the plant and radiation geneticist Ralph Singleton (1900–1982) who would publish the Geneva papers on nuclear radiation in food and agriculture later on but who at that time worked at the Brookhaven National Laboratory in the US.[74] Silow asked Singleton to send him information regarding Singleton's statement on the contribution of atomic energy to agriculture during the congressional hearings on April 1, 1954.[75]

At its first meeting on January 3, 1955, the newly established working party tried to determine their contribution to the upcoming conference. The group began by making assumptions as to whether the conference would be concerned purely with the industrial aspects of atomic power and whether research apart from nuclear physics would be of any interest there. Silow saw the conference as being closely associated with the new agency. He assumed that the specialized agencies had been asked to articulate their interests in the field of atomic energy at the conference in order to provide groundwork on how to determine and differentiate the agenda for the new atomic energy agency. Silow stressed two important points in the discussion. Assuming that industrial use of atomic energy was still 10 to 20 years ahead, the new agency »must be doing something useful in the early

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72 FAO-Archives Rom, RG 40.3 Series A1, Outgoing correspondence by Silow, Silow to Singleton, 23.12.1954.

73 Silow studied Agricultural Botany at Reading and at Wales and earned his doctoral degree in Genetics at Reading. Silow gained his professional experience as a geneticist at the Empire Cotton Growing Corporation's Cotton Research Station in Trinidad and the West Indies. Later on he got a position as Visiting Professor in Plant Genetics at Virginia University in the US before he was appointed as Agricultural Research Officer at Cambridge University and then as Director of Science for the British Council in China. The FAO offered him the post of Technical Officer of the Plant Industry Branch of the Agricultural Division in Rome that he accepted in 1952. See Ronald Alfred Silow Collection, Biographical Information, available at http://www.nationalarchives.gov.uk/nra/onlinelists/GB%200440%20Silow.pdf, accessed November 8, 2012.

74 Willard Ralph Singleton was a Harvard trained plant geneticist who became famous for establishing a hybrid sweet corn breeding program at the Connecticut Agricultural Experiment Station in New Haven. During his first sabbatical leave (September 1937–April 1938) at the University of Missouri L. J. Stadler introduced him into the new field of radiation genetics. At Brookhaven National Laboratory, where he served as a senior geneticist from 1948 to 1955 he laid out a gamma-radiation field around the first cobalt-60 source for studies on radiation-induced mutations in growing plants. He went on with this research at the University of Virginia where he was appointed as Miller Professor of Biology and Agriculture as well as Director of the Blandy Experimental Farm of the University of Virginia. He attended the first Geneva Conference in 1955 as an official US representative and then edited the papers from the food and agriculture panel at Geneva. See Galinat, *Singleton*, 1983, pp. 197–198.

75 FAO-Archives Rome, RG 40.3 Series A1, Outgoing correspondence by Silow, Silow to Singleton, 23.12.1954.

stage before it gets its teeth into the energy problem.«[76] He went on: »If our interpretation of the Resolution is that the agency is to deal with something more than energy, we must be in a position to give UN the impression that we are able to advise in our special field.«[77] This was a clear claim on the agenda creation process on the part of the FAO in regards to this newly emerging field. When Silow articulated his view of the matter in 1955 he did not yet know that it would be exactly the problem of how to demarcate the tasks and responsibilities in the field of atomic energy among the FAO and the upcoming IAEA that would cause a deep and severe personal crisis for him in his final years of service for the FAO.[78]

In January 1955, however, the working party committed itself to outlining its interests and to envisioning its responsibilities with respect to atomic energy. Silow presented a draft, »The peaceful uses of atomic energy in relation to food and agriculture«, at the second working party meeting on January 26, 1955.[79] The draft fully revealed the contemporary ambivalent attitudes towards atomic energy because it highlighted the hopes for its application in agriculture and at the same time also referred to its hazards. The use of atomic energy for desalting seawater and for warming irrigation water appeared in the draft, as did the use of radiation for food preservation and crop and animal breeding and the manifold potentialities of radioisotopes for research in agriculture and food. But the very same draft also stressed the problems associated with the disposal of radioactive wastes and soil and water contamination. It not only called for studies on the use of water resources for the preparation of atomic fuels and of inert isotopes but also for water cooling especially with respect to its effects on the life of rivers. And it suggested initiating research on potential radiation hazards from accidents. The draft concluded by proposing a role for the FAO in the new nuclear arena. It included the allocation of research priorities, the coordination of research and development, the exchange of technical information on hazards, the training of technical personnel and, finally, the study of the impact and applications of atomic power in agriculture.

After its first two meetings the working group came up with two recommendations.[80] The first one stressed the necessity of the FAO's presence at the Geneva Conference with two publications, one on the rewarding effects of the atom on agriculture and food and another one on the negative aspects of the use of atomic energy. The second recommendation suggested that the new position of an atomic energy officer be established within the agricultural division. He was to act in cooperation with other divisions

76 FAO-Archives Rome, 10 TAC 344-162: Inter-Divisional Working Party on the Uses of Atomic Energy in Agriculture. Minutes of the first meeting, 3 January, 1955.
77 Ibid.
78 An extensive description on how this conflict escalated in the 1960s was published recently, see Hamblin, *Light*, 2009.
79 FAO-Archives Rome, 10 TAC 344-162, Memorandum 25 January 1955, Agenda of second meeting on 26 January 1955 and draft paper.
80 FAO-Archives Rome, 10 TAC 344, Box 3 of 4, First Report of the Inter-Divisional Working Party on the Uses of Atomic Energy in Agriculture, 31 January 1955.

of the FAO. Among his most important tasks on the list that the working group provided was »to promote the development of coordinated cooperative research projects; to maintain liaison with WHO in matters of common interest; to advise and assist in the work of the Atomic Energy Agency as required«.[81] This became Silow's job description. He was appointed to this position when it was finally established within the new Atomic Energy Branch of FAO in September of 1957.[82]

In early 1955 the most pressing matter was preparing the FAO presentation for the Geneva Conference. In this matter Philip Vince Cardon, Director General of the FAO, consulted Gove Hambidge, Regional Representative of the FAO in North America, for advice and information. Hambidge suggested getting the expertise of a US consultant who had no access to classified security information because anyone familiar with classified knowledge would suffer many handicaps. He recommended Jefferson from the USDA for the job. This having been resolved, the next matter on the agenda was content. Referring to the dangers resulting from the tests of nuclear bombs that had scared the world public after the occurrence of several accidents became known in 1954, Cardon stressed in his communication with Hambidge the FAO's responsibility

> of making known to its member countries and to the world at large the danger to animal, fish, and plant life, and consequently to the world's food supplies, of the effects of nuclear explosion and radioactive emanations from nuclear plants, raw materials and waste matter.[83]

In the end, however, he finally gave in to the recommendations of the US advisers not to mention the testing and use of atomic weapons but to focus on the positive aspects of the use of atomic energy in agriculture and food instead. The presentation as it was delivered in Geneva focussed explicitly on the blessing but not the evils of atomic energy. The presentation celebrated the achievements of atomic science as a solution to the world food problem in three ways: reduction of losses in all segments and stages of production, storage, and distribution; increasing productivity; and developing new areas and resources. Silow and Jefferson chose to detail food preservation and storage as their first candidates for radiation-based improvements. The FAO/USDA presentation not only summarized the potential achievements from nuclear radiation for agriculture and food but also stressed the need for international collaboration in research and development. Thus, the FAO, like many other transnational institutions in the post-World War II era, aimed at becoming the manager of a transnational research and development policy.

81 Ibid., p. 4.
82 Phillips, *FAO*, 1981, pp. 111–112.
83 FAO-Archives Rome, 10 TAC 344-410, Cardon to Hambidge, 22 March 1955.

Collaboration and Competition – The Tense Relationship between the FAO and the IAEA

When the FAO defined its tasks and responsibilities in the fields of atomic agriculture and food it also had to determine its relationship to the IAEA. This was a point of major concern from the very beginning, and this relationship was soon to become very tense, as was recently documented by Jacob Hamblin.[84] With the IAEA the UN had included a new structural body in its institutional framework. While the existing agencies focussed their activities on basic human needs such as health, education, science and culture, food and agriculture, as well as labour, the IAEA was built around a single technology. Because it was »designed to make it possible for all its members to have access to processed fissionable materials, the plants and equipment by which they can be produced and the related technological training«, it resembled an engineering development office. The organizers defined the new agency as a banker and broker who may arrange contracts between members or furnish the requested assistance from its own bank of materials.[85] Thus, the field of activity assigned to the IAEA overlapped with the area of responsibility of the already existing UN specialized agencies. At the first general IAEA conference in Vienna from October 1–23, 1957, the participants pointed to this structural overlap of competencies. FAO branch officer Ronald Silow repeatedly referred to this problem in his statement. He pointed out that nearly all biological applications of atomic energy could make important contributions to agriculture and this led him to the conclusion that food and agricultural authorities of UN member governments would contact the FAO for advice and guidance in the new fields. Silow went on:

> This is a situation that must inevitably lead to duplication unless there is close collaboration between FAO and the Atomic Energy Agency in the planning of work on the biological applications and implications of atomic energy, with a rational allocation of particular activities to whichever one of those agencies that is better equipped, by reason of its particular resources and experience, to undertake these activities.[86]

Contrary to this plea for close collaboration Silow claimed a leading position for the FAO with respect to all matters nuclear in agriculture and food in the very same statement. He gave sound reason for this when he called for a proper place for nuclear activities in national food and agricultural research and development programs and policies as a whole in order to make sure that the most appropriate methods were chosen at the local or regional level. Exploiting the atom must not supersede conventional methods with their still vast potential for major improvements in agriculture and food. Thus, the plant geneticist and FAO atomic officer in charge, Ronald Silow, was very well aware of

84 Hamblin, *Light*, 2009.
85 FAO-Archives Rome, 10 TAC 343-15/1: International Review Service, The International Atomic Energy Agency, January 1957, p. 6.
86 FAO-Archives Rome, RG 40.3H1: Silow, Statement: Representing the FAO at the First General Conference of the IAEA, Vienna, October 1957.

potential conflicts that could arise from a new technology that was to be implemented on political grounds within the context of the Cold War.

In August 1958, less than a year after Silow delivered his statement at the first IAEA conference, both agencies prepared to establish a joint FAO/IAEA division in order to coordinate their nuclear work in agriculture and food. But the negotiations went slowly and Silow bitterly complained about the appropriating nature of the IAEA planners and the IAEA's activities. In an internal report to the Director of the FAO Agriculture Division, Dr. F.T. Wahlen, Silow wrote: »Now we have evidence of the very danger to which I directed attention several years ago – that an agricultural program in the atomic Energy Agency would be largely in the hand of nuclear physicists without experience of the practical problems of agriculture.«[87] As the only way out of this problem Silow proposed taking the initiative and making sure that the Division would be staffed with »potential recruits of sufficiently broad experience, who are not solely ›isotopists‹«.[88] It would be, however, six more years before the Joint Division of FAO and IAEA finally came into being, which makes it apparent that both agencies were facing enormous problems when it came to agreeing on the terms of collaboration.

Until the Joint Division was firmly institutionalized and to some extent also thereafter, both agencies competed severely to build up an atomic food and agriculture branch. They offered similar activities to get new parties within the UN member states and beyond interested and involved. Facilitating the exchange of scientific and engineering knowledge, sponsoring training courses for the use of radioisotope, providing technical assistance for national projects, organizing topical conferences and symposia and promoting the emergence of transnational research networks: All this kept the atomic agriculturalists and heads of both agencies busy. The IAEA protagonists, however, did have some other instruments at their disposal for developing the new field. They offered fellowships and research contracts. And they also incorporated research projects after the IAEA opened its laboratory at Seifersdorf near Vienna. Researchers from member countries were invited to use the facilities for joint projects. Thus, the IAEA not just promoted but also conducted research on atomic food and agriculture.[89]

It will come as no surprise that there was a lot of topical overlap in the work of both agencies. Food irradiation was a field of great interest that both agencies fostered at the same time. Furthermore, both agencies eagerly engaged in work with radioisotopes. Radioisotopes had become heavily used research tools as tracers since they could be produced easily and because they stood – for a long while – as the sole proof of peaceful use of the atom.[90] Thus their use was promoted for political reasons at first by the USAEC

87 FAO-Archives Rome, 10 TAC 343-1515: Silow to Wahlen, 4 August 1958; Relations with the IAEA, p. 3.

88 Ibid., p. 4.

89 FAO-Archives Rome, 10 TAC 344-115: FAO Representatives at Atomic Energy Meetings 1955–1963; David Fisher (see footn. 20), pp. 354–355.

90 Creager, *Industrialization*, 2004.

and later on by the IAEA. One of the early projects focused on fertilizer research for rice cultivation. Radiation genetics and its application to plant breeding also got a lot of attention from the officers in Vienna as well as in Rome. The IAEA, however, also carved out a project on its own. This was a project on radiation control of harmful insect populations.[91] It worked via radiation sterilization of male insects, which were then released in overwhelming numbers to the native population of the respective insect. The IAEA etymologists took a lot of pride in having developed this method.

Thus, Silow's assumption in early 1955 became true. Via its mandate to foster the peaceful use of the atom the IAEA was occupying more and more intellectual and administrative territories that the FAO claimed as their own. In a letter to FAO Assistant Director General Boerma from July 24, 1961, Silow repeated his old apprehension in an angry reproach. »The manner in which the IAEA is assuming independent leadership in agricultural matters is scientifically inappropriate as if the European Coal and Steel Community were to undertake training in modern surgery – on the grounds that high grade steel is used in the manufacture of surgical scalpels.«[92] Over the next years, and especially after the Joint FAO/IAEA Division on Agriculture took up its business, this conflict would not disappear but increase. At the heart of the conflict was a divergent notion about the role of science and engineering in society. While the protagonists at the FAO considered nuclear technology as one among several potential measures to improve the world food situation via technological innovation, the physicists of the IAEA saw the improvement of nuclear technology as their principal goal. The latter considered their primary task to be the promotion of high-end nuclear technologies, and they made the interest of users subordinate to this task.

At the Geneva Conference of 1955, however, practicing scientists had already voiced a more restrained optimism for atomic food. Bernard Procter (1901–1959), head of the Department of Food Technology at MIT, and his colleague Samuel Goldblith (1919–2001) – both leading researchers and protagonists of food irradiation – stressed the need for much more research on the one hand and pointed to fundamental questions of efficiency regarding applications on the other.[93] Because food production was a seasonal business for many commodities, and many food processing plants were widely dispersed throughout the country and did not operate 24 hours a day, the irradiation sources would be used rather inefficiently. Therefore, Procter and Goldblith saw more potential in meat and

91 FAO-Archives Rome, 10 ADG 351: M. Fried, Application of radioisotopes and radiation sources in agriculture, food production and the food industry with special reference to I.A.E.A.'s work, April 19, 1963. The method originally came into being as a tool of pure science when Nobel Prize winner Muller used the absence of male offspring of drosophila in cross-breeding experiments to demonstrate radiation induced mutations.

92 FAO-Archives Rome, 10 TAC 344–138: Silow to Boerma, 24 July 1961.

93 Proctor/Bernard/Goldblith, *Sterilization*, 1958, pp. 333–345. This book chapter was taken from Geneva Conference Paper 172 on *Progress and Problems in the Development of Cold Sterilization of Foods* by both authors.

dairy irradiation, no wonder since these fields had already been transformed into a vastly industrialized agribusiness that year round produced highly-standardized organic goods.

In the public discourse, however, food irradiation was mostly perceived as a way of extending the shelf life of perishables without refrigeration. Photos of radiation sterilized shrimp or meat that had been stored one year at room temperature were intended to whet the appetite of potential users of the dangerous rays.[94] Consequently, the assumption could be made that processing food by irradiation would work to modernize the food system. This at least was the message heard by protagonists for food irradiation in developing countries, which became targets for atomic food even before the FAO launched the Freedom from Hunger campaign in July 1960. At a conference jointly organized by MIT, the AEC and the IAEA and held at MIT in July 1959, participants from less-developed countries voiced these hopes. The Peruvian delegate, Antonio Bacigalupo from the National School of Agriculture in Lima for example, pointed to the lack of roads and a nearly non-existent food preservation industry in his country. That was why he became enthusiastic about »radiopasteurization«. He dreamt of »the commercial use of radiopasteurization in Peru for extending the storage life of meat cuts, ground beef, pork sausage and cured meats, and also for the improvement of the sanitation of these products, particularly in the case of pork«.[95] Bacigalupo also saw »radiopasteurization« as the key means for increasing fresh fish consumption in his country. Bacigalupo recommended irradiation for sprout inhibition and disinfestation even for potatoes, which were the most important item in Peru's national diet and which the Peruvians had bred over millennia, making potatoes the world's widest variety, fitting various climatological and geographical conditions as well as storage needs.[96] Howard Borough, chief of the Nuclear Energy Program at the Inter-American Institute of Agricultural Sciences in Turrialba, Costa Rica, recommended food irradiation for the same reasons for Central America. He stressed the need to establish a research facility in the region that would promote cooperative efforts among the neighbouring countries and might thus help in preserving not only food but also peace.[97] The Thai conference participant, who was a member of the Thai Atomic Energy Commission for Peace, envisioned food irradiation as a way to overcome diet deficiencies that in turn were due to the inadequacy of the transportation systems, the refrigeration facilities, and the processing factories in Thailand. He hoped to prevent spoilage of dry fishmeal, to reduce the need for refrigeration, and to protect rice bran as an important foodstuff for livestock and poultry.[98] The technical adviser of the Brazilian Atomic Energy Commission and delegate to the MIT conference wanted to use food irradiation to rectify Brazil's problems stemming from a poorly organized food distribution system. For him the advantages of irradiation included

94 For images see Desrosier/Rosenstock, *Radiation Technology*, 1960, p. 305, 307, 309.
95 Bacigalupo, *Possibilities*, 1959, p. 207.
96 Ibid., p. 208.
97 Boroughs, *Problems*, 1959, p. 215.
98 Cheosakul, *Potential*, 1959, p. 220.

installation that was less bulky than steam and the adaptability of mobile installations. Radiation sources could be brought to production centres or used as stationary facilities at slaughterhouses, fishing piers or large silos. He considered the technology's greatest potential to lie in the combined use of refrigeration, radiation and antibiotics.[99] Two representatives from the Indian Atomic Energy Establishment reported on a newly founded group for studying food irradiation and other applications. It planned to operate research-scale irradiation cells and then set up a pilot plant. Although the group considered bananas to be the most promising food item to be irradiated due to transport problems, it also expected to see the irradiation of potatoes for solving storage problems, of mangoes to enhance their potential as export fruit, and, later on, of grain to prevent infestations.[100] Other national delegates at MIT also expressed similar hopes and visions of a bountiful global buffet made safe by irradiation.

Four years later, on the occasion of the opening of the US Army Radiation Laboratory at Natick, MA, with its massive cobalt-60 source and a linear accelerator, the attendant FAO representative, Charles Weitz, announced that food irradiation would contribute to the FAO Freedom from Hunger campaign. Referencing the still-unresolved uncertainties as to the safety of irradiated foods, he urged policymakers to find an adequate balance between benefits and risk that was appropriate for developing countries. As Weitz said: »When the question is whether to have food for people to eat, even if the food is not of highest quality, or not to have it available at all, the considerations are different from conditions allowing a choice of food of the highest quality.«[101] With such a relativist and highly problematic notion on food safety the FAO Freedom from Hunger campaign provided a justification for developed countries in the West and the East to treat developing countries as an excellent experimental site for food irradiation. How this problematic notion materialized in food irradiation projects in developing countries is the subject of further studies.

Nuclear Methods in Food and Agriculture – A European Project

It was not just UN-affiliated organizations that started to develop transnational projects for an atomic kitchen. In Europe, too, scientists, engineers and politicians began to set up not only national nuclear programs in agricultural and food but also transnational projects and networks. In the 1950s, the USA supported many of these European projects and networks, either by initiating them or promoting them very actively. One famous example was project number 396 on the application of atomic science in agriculture and food

99 Cimbleris, *Prospects*, 1959, pp. 224–225.
100 Nair/Taylor, *Application*, 1959, pp. 244-247.
101 Weitz, *Freedom*, 1963. Weitz, who was a US citizen and trained as a political scientist, joined the United Nations in 1947. From 1960, the year when the Freedom from Hunger campaign was launched, until 1971, he acted as International Coordinator of the FAO Freedom from Hunger campaign. Obituary Carles H. Weitz 1919–2012, available at http://antiochcollege.org/news/obituaries/4048.html, accessed February 12, 2013.

conducted by the European Productivity Agency (EPA) in the years from 1957 to 1959. This agency was established as a conveyer for the US-European productivity mission but soon developed into an institution through which European participants gained considerable influence on the agency's agenda setting activities.[102] EPA project number 396 organized missions to the US and to Britain in order to teach Western Europeans nuclear techniques and their application in agriculture and food. A big international conference was also held in Paris in 1958 that provided a survey on what was happening in the field in Europe. Thus, this project paved the way for the emerging European research networks.[103]

A second example of US-inspired European networks with relevance to atoms for food was Euratom. Euratom was a brainchild of the Eisenhower administration, dedicated to fostering European integration, thereby strengthening American hegemony in Europe via transnational nuclear collaboration and, with it, checks on nuclear weapons proliferation.[104] After a clumsy start, the State Department tried to breathe new energy into the Euratom project. In 1958 it set up a joint program for reactor construction as well as research and development programs. In the end, only the latter worked, but this was how Euratom became an additional chef in the atomic kitchen. Euratom's second R&D five-year plan (1961–1964) established a biological program with a decent percentage of 3.5 of all research expenditures.[105] A predominate share of the program's budget (71.5 per cent) was dedicated to research on radiation hazards. But another 23 per cent of it was to be spent on the application of nuclear technology, and nearly four-fifths of this money was budgeted for applications in agriculture and food.[106] This part of the program included work on food irradiation. It was coordinated at the Dutch Agricultural University in Wageningen and implemented via research projects that were co-sponsored by Euratom but conducted nationally.[107] Euratom, however, not only sponsored research but also publicity campaigns for increasing the acceptance of industrial irradiation and food irradiation. In 1967 and 1968 Euratom organized and conducted »IRAD 1967–68«. This was a campaign to demonstrate irradiation techniques for industrial applications and especially food irradiation, using the French Company Conservatome's mobile pilot automatic industrial irradiator IRMA with a capacity for 500,000 curies of caesium-137. The mobile irradiator toured through Germany (Bremerhaven, Kiel, Düsseldorf, Munich); Belgium (Charleroi, Courtrai); France (Lyon); the Netherlands (Wageningen) and Italy (Rome, Milan). The tour was accompanied by a technical exhibition on the possibilities of

102 Boel, *Agency*, 2003.
103 For more information on EPA-project 396 see Zachmann, *Food*, forthcoming 2013.
104 Krige, *Peaceful Atom*, 2008, pp. 5-44.
105 BA Koblenz, B 116, Folder 15503, Das Biologieprogramm von Euratom 1961–1964, Bericht und Ausblick von R.K. Appleyard, p. 5.
106 Ibid., table 2.
107 Ibid., pp. 41–43. One of these Euratom sponsored projects centred on the industrial processing of irradiated potatoes. Research institutes in the Netherlands, Belgium, Germany, France and Italy participated. The project lasted several years from the late 1960s to the early 1970s. See Grünewald, *Experience*, 1973, pp. 7–11. For more Euratom-sponsored activities see Progress of Food Irradiation work. In: Food Irradiation 9 (1969), no. 1, p. 31, and subsequent issues of the newsletter.

irradiation applications, an exhibition that was visited by 350,000 people. During the campaign over 13,000 packages containing raw food materials or finished products were irradiated. The organizers celebrated the campaign as a great success. A report was published by the Bureau Eurisotop, a publication series of Euratom.[108] Euratom-sponsored atomic food cooks were part of the transnational network and contributed decisively to its development.[109] But as Euratom remained confined to six Western European countries it met with disapproval from excluded countries. Thus, Euratom acted rather as an assistant cook than as a chef within the transnational atomic kitchen.

In contrast to these American-sponsored networks, a purely European one had emerged by the end of the 1960s. In 1969 scientists founded the European Society for Nuclear Methods in Agriculture (ESNA). Still existent, the organization changed its name to European Society for New Methods in Agriculture in 1983, and we will soon see why. Why did an independent society emerge in Europe roughly fifteen years after the first atomic euphoria? Was it because US foreign policy in the late 1960s and early 1970s shifted to one of Cold War détente? Who initiated this society? What goals did its founders set? How did the society transform Eisenhower's vision of the peaceful atom? What position did ESNA acquire within the Cold War world?

Two professors from two universities took the initiative and established ESNA. The first professor held a position at the Dutch Agricultural University Wageningen. Via Eisenhower's research reactor program, this university acquired such a reactor and devoted it explicitly to agricultural research. Wageningen became a well-known agricultural nuclear research centre and coordinated the agricultural part of the above-mentioned Euratom biology program.[110] It also handled important tasks within European research projects on food irradiation. Dick de Zeeuw (1924–2009) headed the Wageningen Institute for the Application of Atomic Energy in Agriculture from its establishment in 1958 to 1976. De Zeeuw received his PhD in Wageningen in 1954 based on a study on how plant leaves influence blossoming. After his dissertation he went to the US where he studied biochemistry and biophysics, thus moving toward nuclear research. As one of the initiators of ESNA, de Zeeuw always held a leadership role within the organization, and in 1973 he became its president.[111]

108 Bureau Eurisotop-Euratom, Technique d'irradiation, Action IRAD 1967–1968, Rapport général, Bruxelles 1969.

109 Euratom also sponsored international colloquia. Held in October 1970, one of these colloquia dealt with the pressing issue of how to identify irradiated foods. That is, how could a nation or a consumer in that nation know whether an imported food had been subjected to ionizing radiation.

110 BA Koblenz, B 116, 15503, Das Biologieprogramm von Euratom 1961–1964, Bericht und Ausblick von R.K. Appleyard, p. 42.

111 For biographical information on Dick de Zeeuw see Wikipedia. On his activities in ESNA see ESNA-proceedings.

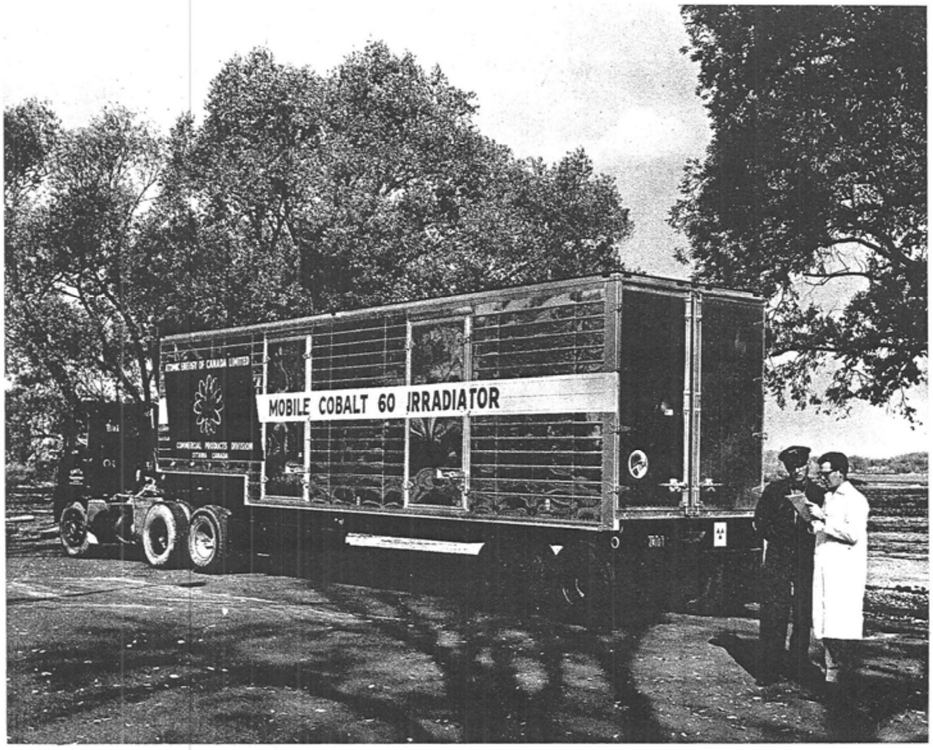

Figure 13: Mobile Food Irradiator. This is not IRMA but a Canadian mobile irradiator. It was built in 1962 and toured the country in order to demonstrate potato irradiation.

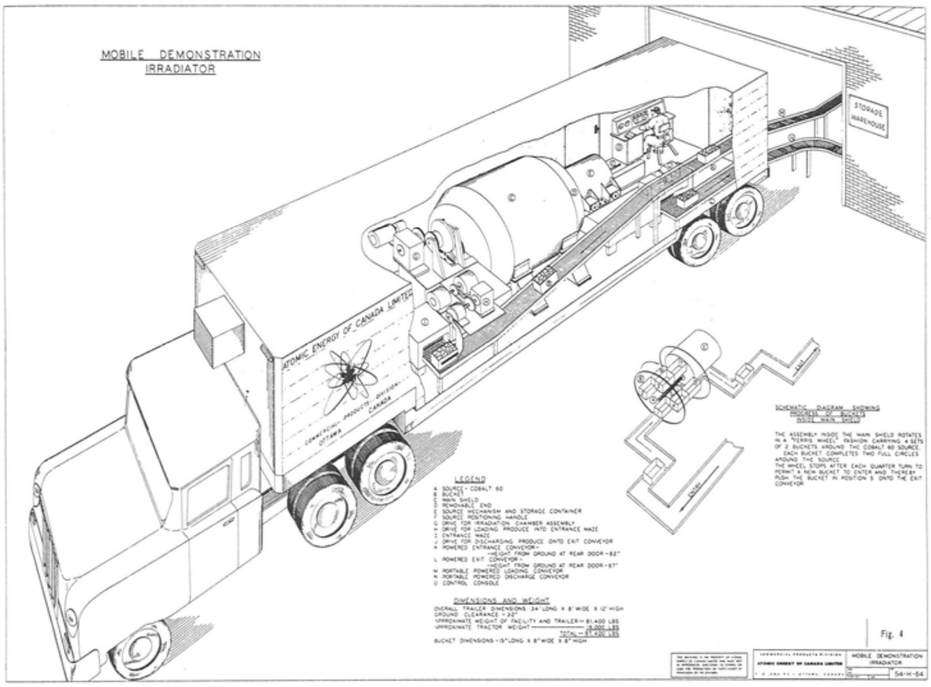

Figure 14: Mobile Food Irradiator.

The second university involved was the Technical University Hanover, where the Institute of Radiation Biology was founded in 1959. Physicist Hellmut Glubrecht (1917–2009) was appointed as chair to the institute. He had studied physics in Hanover, receiving his PhD there in 1943 and defending his habilitation there as well in 1951. He then taught biophysics at the Veterinarian College in Hanover. By the mid-1950s Glubrecht had commenced research on radiation-induced mutations with plant geneticist Hermann Kuckuck (1903–1992). At the Institute of Radiation Biology (renamed the Institute of Biophysics in 1973), Glubrecht directed fundamental research in biophysics and also applied agricultural research. In order to secure the institute financially – it was initially sponsored by the Atoms Ministry – Glubrecht integrated the institute into the Society of Radiation Research Neuherberg, an institution of Big Science in West Germany and, as such, financed by the Federal Government. The research of Glubrecht's department was influenced by the fact that the Society of Radiation Research was moving in the direction of environmental studies. Glubrecht's department changed its name to the Department of Ecological Physics in 1979. Glubrecht had already established environmental research as one area of focus at ESNA. Before he was appointed Deputy Director General of the IAEA, Glubrecht acted as the first president of ESNA from 1969 to 1973.[112] De Zeeuw became the next president of ESNA.

On September 16, 1969, 98 participants from 16 European countries on both sides of the Iron Curtain convened at the founding meeting of ESNA in Wageningen, the Netherlands.[113] From the beginning the society's annual meetings were held every year in a different European location, both in the West and the East. The society included especially active Eastern and South-Eastern European members including Hungary, Poland, Czechoslovakia, and Romania as well as nonaligned Yugoslavia. In 1974 both the USSR and the GDR became members. Thus, nuclear research in agriculture and food grew into an area of cross-bloc collaboration and interaction. Here scientists broke open the politically fortified boundaries of the Cold War world and contributed actively to an emerging policy of détente. Whereas Eisenhower's Atoms for Peace initiative emerged in the spirit of containment and promoted collaboration with an impetus of American control, the scientists who participated in ESNA strove for European integration in the area of science in order to mobilize more resources and to enhance their own positions in their particular national contexts. In his speech at the founding meeting Glubrecht mentioned that one of his visions for ESNA was that it would contribute to the strengthening of European technology.[114] In this regard, the scientists from the West

112 Ehrenstein, Dieter von: Nachruf auf Professor Dr. Hellmut Glubrecht, 17.2.2009, available at http://www.vdw-ev.de/images/stories/vdwdokumente/aktuelles/Nachruf%20Glubrecht.pdf, accessed November 8, 2012; Glubrecht, *Institut*, 1965; Zentrum für Strahlenschutz und Radioökologie, Leibniz Universität Hannover, 50 Jahre Strahlenforschung in Herrenhausen, Hannover 2007, available at http://www.strahlenschutzkurse.de/vorlagen/50jahrfe.pdf, accessed February 5, 2013; Reuter-Boysen, *Strahlen- zur Umweltforschung*, 1992, pp. 176–187.

113 Glubrecht, *Report*, 1970, pp. 9–15, here p. 9.

114 Ibid., p. 14.

thought of their colleagues from the East as interesting partners because, as the Western scientists thought, nuclear research was held in greater esteem in the East, and practical applications were more easily achieved in nationalized economies. Furthermore, by envisioning ESNA as a means to improve European performance in science and technology, Glubrecht connected ESNA's founding to the on-going Western European discourse on the growing technological gap between the US and Western Europe. Thus, ESNA was to become part of the European response to the American challenge in science and engineering.[115]

In his report on ESNA's founding meeting, President Glubrecht outlined his thoughts on the need for the new society. Agriculture was becoming an area for the application of high technologies such as nuclear technology and electronic data processing. The use of nuclear technology in agriculture, however, required the close collaboration of physicists, chemists, biologists and agricultural scientists, as well as excellent nuclear equipment and also control and safety installations. Therefore, it would be appropriate to speak of a new type of research, *nuclear agriculture*. Glubrecht referenced a similar situation in medicine, where *nuclear medicine* had been successfully established as a new, special field of research and practical application. Glubrecht further argued that nuclear agriculture had not yet coalesced, although its future prospects were much bigger if one thought of the many possibilities for application, e.g., in soil science, plant and animal physiology, breeding, pathology and food processing.[116] The plan was to make sure that researchers in the field of nuclear agriculture were well connected in two areas: in their respective fields of specialization in agriculture, forestry and horticulture on the one hand, and in nuclear physics, radiochemistry and radiation biology on the other.

Thus, the founders of ESNA tried to establish a new transdisciplinary research area. What defined this new area was not its subject but the fact that the new field focused on research technology and experimental design, i.e., nuclear techniques. As Glubrecht argued, methods had very often been the point of departure for the development of new subject areas in agriculture and food research. He mentioned low-dose, radiation-induced stimulation, food sterilization with ionizing rays, and radiation genetics as examples.[117]

Whereas the foundation of ESNA was a success and the society developed a whole range of activities, it did not accomplish the self-assigned task of developing nuclear agriculture as a new research discipline. A main reason for this was the advancement of genetic engineering, because this new field restructured the whole area of agricultural research. However, new experimental systems such as isotope research or radiation genetics that came into being on the basis of nuclear techniques helped prepare the

115 On the gap-discourse see Godin, Benoit: Rhetorical numbers. How the OECD Constructs Discourses on S&T. Project on the History and Sociology of S&T Statistics. Working Paper No. 19, 2002, available at http://www.csiic.ca/PDF/Godin_19.pdf, accessed November 8, 2012. As a source to this discourse see Schreiber/Strauß, *Herausforderung*, 1968; Ritter/Szöllösi-Janze/Trischler, *Antworten*, 1999.

116 Glubrecht, *Report*, 1970, pp. 9–13.

117 Glubrecht, *Annual Report*, 1970, pp. 23–27, here p. 25.

genetic engineering field. Researchers changed fields and went from radiation-induced mutation breeding into molecular plant breeding. ESNA survived the change of methods and it gave the N in its acronym another meaning: New. In 1983, it became the European Society for New Methods in Agriculture. Though renamed, the society is remarkable for its goal of integrating research across Europe well before the emergence of the EU while also carving out its own field of activity.[118]

Integration Before European Unification – ESNA Defines its Sphere of Activity

What concerns us here, however, is ESNA's nuclear development phase from 1970 to 1982, which coincided with a period of marked structural changes throughout society. Those were the years in which the post-war boom came to an end. The euphoria of progress and growth was replaced by an increasing scepticism for which there were many strong reasons: The break-up of the international monetary system (1971/72), the first oil price shock (1973/74), the global food crisis (1972–75) and the emergence of a new environmentalism, which initially presented itself as an anti-nuclear movement in various countries of Western Europe. Further doubts were fuelled by the declining cohesion within the two political blocs as a result of the Vietnam War on one side of the Iron Curtain and the Prague Spring on the other. What could European research in the field of agriculture and food expect from nuclear technologies and scientific cooperation superseding the boundaries of the political blocs in this age of »the landslide« as the great British historian Eric Hobsbawm has characterized this period?[119]

ESNA's founders declared two objectives at their inaugural meeting. Nuclear techniques for use in agriculture were to be subjected to critical evaluation and subsequently developed further to promote practical applications in crop and livestock production. This was seen as an avenue to solving two pressing global problems, namely safeguarding basic food supplies for the exploding world population and containment of environmental pollution occasioned by increased industrial and economic growth.[120] These objectives could only be attained through international cooperation, for which ESNA sought to follow the example of the Joint FAO/IAEA Division in Vienna. The focus for ESNA was to be placed not on scientific policymaking but rather on immediate scientific research in a total of ten working groups devoted to the following topics: 1. Technological aspects of food irradiation; 2. Radiation-induced stimulation effects in plants; 3. Isotope techniques in animal science; 4. Radiation analysis; 5. Nuclear techniques in the study of soil-plant relationships; 6. Practical mutation breeding; 7. Nuclear techniques in agriculture protein research; 8. Environmental pollution; 9. The use of genetic manipulation for pest control; 10. Radioisotopes in insect ecology.

118 On the rise of biotechnology see Zeeuw, *Biotechnology*, 1982, p. 95.
119 Hobsbawm, *Zeitalter,* 1995.
120 Zeeuw, *Research Policy*, 1970, pp. 31–34.

This structure duplicated the task definitions of the Joint FAO/IAEA Division in a number of its working groups (food irradiation, tracer techniques in soil, plant and animal science, radiation genetics, pest control). ESNA likewise planned to initiate joint research projects and to conduct joint experiments.[121] Whereas cooperation in Vienna was bound to government agreements, ESNA, as a scientific society, was more flexible in its options. There was nevertheless very close networking at various levels, as reflected in Glubrecht's four-year appointment as Deputy Director General at the IAEA (1973–1977) and the fact that the spring sessions of the ESNA board were always held in Vienna. That seems to indicate an intention to strengthen European influence in the specialist UN organisations on the part of ESNA's founders, who in this way hoped to secure access to the research resources that were becoming scarcer in European national contexts.

The ESNA board also followed the example of the Vienna program in that it attempted to anchor ESNA's work in the context of development politics. Moral support in this direction came from the Fourth Geneva Conference on the Peaceful Uses of Atomic Energy (1971), at which the Chairman of the US Atomic Energy Commission, Glenn Seaborg, emphasised in his opening address that hunger in developing countries called for a reappraisal of risks and benefits and that greater importance should be attached to food irradiation as a means to reduce perishability losses. Other speakers underlined the possible contributions of nuclear techniques to the cultivation of high-yield grain and corn varieties.[122] Participants from developing countries signalled great interest in the use of nuclear techniques in agriculture, leading Dick de Zeeuw to conclude in his conference summary at the ESNA Annual Meeting in 1971 that the demand for applied nuclear technologies in developing countries was much greater than in developed countries. His suggestion was that ESNA should attempt to conclude bilateral agreements with developing countries on nuclear research for agriculture.[123]

The impact of the global food crisis, 1972–1975, with the price of grain more than tripling within a span of 20 months and a series of famines ranging from Haiti, the Sahel zone and Ethiopia to India and Bangladesh, strengthened ESNA's resolve to offer developing countries technical »solutions« in which there was insufficient interest in Europe.[124] The society could assist in training experts (the Catholic University of Leuven, for example, was the only European university to offer a specialisation in food irradiation in its Master and PhD programs), could contribute to establishing research centres in developing countries, and could itself realise projects that were important to these countries. In this context, ESNA's strategic planners took up topics that had already been treated as projects of core interest by the Joint FAO-IAEA Division for many years.

121 Ibid., p. 31.
122 IAEA Bulletin 135, available at http://www.iaea.org/Publications/Magazines/Bulletin/Bull135/13505100218.pdf, accessed November 8, 2012, p. 135.
123 Zeeuw, *Opening Address*, 1971, pp. 16–17.
124 On the world food crisis see Gerlach, *Welternährungskrise*, 2005, pp. 546–585.

Radiation Preserved Food for European Menus – ESNA Strategies for Boosting Food Irradiation

In the first part of this paper I demonstrated that many actors on the national and the transnational level were busying themselves with bringing irradiated food to the dinner table. By the end of the 1950s – at first in the US and then also in many other states – national food legislation forbade food irradiation across the board based on increasing concerns about chemical contamination and nuclear fallout. Treating irradiation as a food additive, these bans required the protagonists of the new preservation technology to apply for approvals for making use of food irradiation. For the sake of building trust these approval procedures prompted the protagonists of food irradiation to develop a safety concept and to determine appropriate methods for proving it. To this end the activists of national food irradiation programs, with the help of international institutions such as the FAO, the IAEA and the WHO, developed the concept of *wholesomeness* and set up *wholesomeness* studies in order to develop appropriate data for proving the safety of irradiated food. This procedure, however, was seriously challenged in 1968 when the US FDA not only rejected an Army application for approving the irradiation of ham, but even worse, also rescinded previously granted approvals. Though this action was actually targeted at strengthening trust in the work of the FDA at the national level, it seriously challenged the trust building process in food irradiation at the international level. In response to these American developments, the European protagonists of food irradiation reinforced their transnational collaboration. They set up the International Food Irradiation Project (IFIP) that was coordinated by the German irradiation researchers in Karlsruhe but had been supported by the IAEA from the very beginning. The project aimed at establishing an internationally codified safety standard.[125] The ESNA also worked in the field of food irradiation. The first working group that was established by the society dealt with technical aspects of food irradiation with the goal of transferring the process into commercial use. One of the most explicit promoters of commercial food irradiation was the Swiss industrial researcher Friedrich Münzel, who worked for the Corporation for Industrial Research and Radiation Application, INRESCOR. Münzel called for more cooperation between governments and industry. For winning commercial collaborators, Münzel suggested combining irradiation projects with more food improvement processes such as protein enrichment of wheat flour, baby food or convenience food and soups. Münzel saw a chance to advance commercial food irradiation by combining technological refinement processes that transformed foodstuffs into industrial goods with indefinite shelf life and new characteristics that had not naturally emerged but had been technologically made and that were useful for producers and retailers but not for consumers.[126] Münzel, however, suggested still another way to put irradiation to

125 Zachmann, *Atoms*, 2011.
126 Münzel, *Strength*, 1970, pp. 34–38.

commercial use. In 1970 he proposed irradiating waste and sludge. The process would accelerate the separation of organic substances from waste, which then could be used as fertilizer. Irradiation would hygienically improve waste and sludge. The process could be also applied to industrial wastewater from paper mills and chemical plants. From this point on, the irradiation of wastewater was an often-discussed topic in the food irradiation working group. The 1974 meeting discussed a report on a pilot facility that was called a *hygienization* plant erected near Munich. This plant irradiated sludge with gamma rays from a cobalt-60 source in order to sterilize sludge that was to be used as fertilizer afterwards.[127]

In 1975 the irradiation working group split in two, with one group devoted to food irradiation and the other to waste irradiation. At the next meetings, members not only discussed the use of irradiated sludge as fertilizer but also advocated that it be used as an ingredient in animal feed. As for radiation sources, the working group members discussed the application of used fuel rods from nuclear power plants (Cs 137). In 1978 the working group calculated how much caesium-137 would be available until 1990 based on the projected increase of nuclear power production in Belgium, Great Britain, France, Germany, Italy, Sweden, Switzerland, the Netherlands and the United States and how much irradiated sludge could be provided for the agribusiness. Like the Valiant Little Tailor, the sludge irradiator wanted to catch a large number of flies in one blow. The hygienization projectors wanted, 1) to utilize nuclear waste and thus treat the problem of waste disposal, 2) to use sludge for the production of animal feed and thus indirectly also of food, and 3) to reduce energy consumption.[128] Nuclear techniques for waste treatment were to be developed for developing countries as well. The Institute of Radiation Botanics headed by Glubrecht worked on this project.

Both the Joint Division and the ESNA still exist today, and both institutions are still pursuing and promoting the application of nuclear techniques in agriculture. The aura of a horn of plenty with the ability to transform all shortages into abundance, however, has faded. Food irradiation has remained a niche technology for special products and has been unable to establish itself as a general method of refinement and conservation in food supply systems. On the contrary: The marketing strategies of some major food companies, such as Heinz, spotlight the safe nature of their products by emphasising that they forego nuclear irradiation. At the same time, however, protagonists of food irradiation, such as the Joint FAO/IAEA Division of Nuclear Techniques in Food and Agriculture continue to devote remarkable efforts and resources into developing irradiation as a standard food processing technology. In 2009, e.g., IAEA published the results of a coordinated research project on the application of irradiation to ensure the safety and quality of prepared meals.[129]

127 Süß, *Pilot Plant*, 1974, p. 35; Süß et al., *Versuchsanlage*, 1974, pp. 65–70.
128 Groneman, *Report*, 1978, pp. 69–73.
129 Irradiation to ensure the safety and quality of prepared meals. Vienna : International Atomic Energy Agency, 2009. Available at: http://www-pub.iaea.org/MTCD/publications/PDF/Pub1365_web.pdf, accessed April 28, 2013.

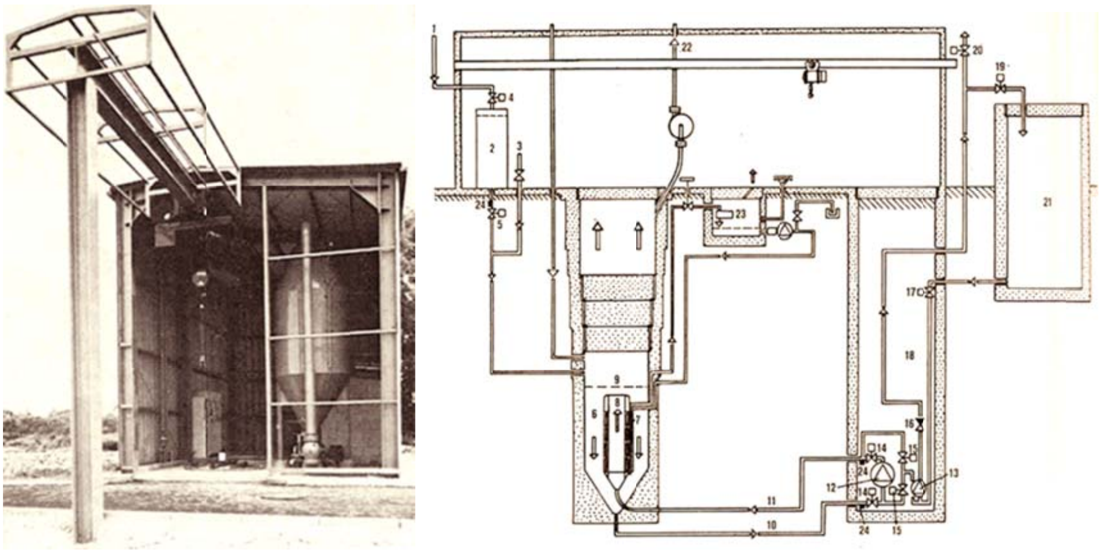

Figure 15: Sludge Hygienization Pilot Plant near Munich 1974.

Conclusion

This paper has dealt with an innovation that first emerged as a radiation-employing experimental system roughly by the 1930s. Within the context of World War II and especially in the first decade of the Cold War, protagonists of the nuclear establishment (the military, governmental officials such as representatives of US Atomic Energy Commissions and other national agencies, science managers, researchers, and others) became interested in these experimental systems and their elements – e.g., radioisotopes or ionizing rays that were used to explore processes of life – not primarily in their capacity to produce new ways of knowing, but because of their potential to yield new ways of doing. Therefore, these protagonists pushed the experimental systems into the world outside the laboratory at an early stage of their development. What at first emerged out of scientific curiosity to learn how ionizing rays would influence living matter was quickly employed to serve political purposes under the circumstances of the Cold War. This happened when, e.g., ionizing rays of such radiation employing experimental systems were applied to agriculture and food in order to prove that the atom could be put to peaceful use. Such applications of methods and techniques from experimental systems developed into powerful hybrids of science, technology and politics that decisively determined the global distribution of knowledge and control in and beyond the Cold War era. These hybrids still exist, even though the Cold War ended two decades ago. They exist as projects to introduce high-dose irradiation to ready-made food in order to serve the need of food industries and food retailers to increase turnover and profits. So far, only attentive representatives of consumers have challenged these projects via the mobilization of counter-expertise to the food-safety promises of the Joint FAO/IAEA Division and the Codex Alimentarius Commission. The fight over the safety of irradiated food, ironically, has itself become a »Cold War« of its own.

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