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Physics in Perspective

Dreams of Declassification: The Early Cold War Quest for Nuclear Knowledge in The Netherlands and Norway

Machiel Kleemans*

This article seeks to explore the relation between nuclear physics and secrecy in early Cold War Europe. After World War II, nuclear physics re-emerged from the Manhattan Project as a largely classified field. Over time, the boundary between secret and unclassified information set by the United States moved due to both political and scientific developments. This shifting boundary of secrecy is taken as a place to investigate power relations in the context of Cold War Science. The Netherlands and Norway are two countries with early nuclear programs that tried to move this boundary, in part by building a joint reactor in 1951. Whereas they requested classified information from the US in 1946, their programs developed to a point where the US made requests to classify nuclear information in Europe by 1960. Between 1954 and 1960, the joint reactor program became the site of a multilateral intelligence operation. Secrecy was used as an intelligence tool to spread nuclear disinformation to the Soviet Union. This history shows how (de)classification opened and closed windows of opportunity and sheds light on the effectiveness of classification.

Key words: History of nuclear physics; declassification; Secrecy; Norway; The Netherlands; Nuclear intelligence.

Introduction

"Real power begins where secrecy begins," Hannah Arendt once stated.[1] In the case of nuclear physics, secrecy and nuclear science were closely intertwined from its early development in the Manhattan project in World War II. During the war, secrecy kept the development of nuclear weapons in the United States out of the public eye and that of its Axis adversaries. A major shift in the boundary of secrecy occurred with the use of the atomic bombs in August 1945. The subsequent publication of the Smyth Report shared basic principles of how these bombs were made, but without technical details. The report determined what could and could not be shared about the atomic bomb, thus establishing a new boundary for

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secrecy. Since then, the boundary of nuclear secrecy has shifted multiple times, sometimes in small steps, sometimes in large strides.

Changes in that boundary are interesting as they reflect changes in power relations. As John Krige has noted with respect to American secrecy:

> The boundary between sharing and denying is not fixed. Multiple stakeholders… negotiate and renegotiate the context-laden boundary between what knowledge can be shared and what knowledge must be denied.… the boundary that is drawn is not simply a bureaucratic necessity. It is a site that renders American power visible.[2]

This last sentence reflects Hannah Arendt's observation. The boundary of nuclear secrecy—a site that renders American power visible—is a natural place to investigate power and influence in the early Cold War. It was certainly recognized as a site of power in countries outside the American nuclear monopoly. Scientists and diplomats around the world carefully observed it and, in many cases, indeed tried to renegotiate it. As Gordon Dean, chairman of the US Atomic Energy Commission, observed in 1950: "Our criteria for declassification must change as the events of the world change."[3] Clearly, the boundary of secrecy in the early Cold War equally renders American power visible as well as the relative powerlessness of countries outside the nuclear monopoly.

The study of how and why the perimeter of secrecy has changed over time can be approached from different perspectives. A principal distinction is between those who designed and developed secrecy—those inside the system—and parties who were denied information—those outside the system. Within these groups many different actors can be identified working in science, government, commercial industry, or in public media. The actions within each of these groups were entangled to different degrees and in order to acquire a comprehensive understanding of the changing scope of secrecy, it is helpful to consider the interplay between these various actors in a transnational setting. In this article, I will consider how these actors in primarily the Netherlands and Norway navigated under the American regime of secrecy and nuclear control.

Directly after World War II, nuclear secrecy was primarily an American initiative that transcended borders by design, as it was meant to keep other countries from obtaining nuclear technology. In order to understand its causes and effects, it is worthwhile to consider the distinct perspectives of experts, state officials, and the public not only from a national but from a multinational point of view. A lot of the work on nuclear secrecy has focused on the American perspective, but much can be learned by looking at how smaller countries in Europe with nuclear ambitions operated in the early Cold War. These countries in Europe were stymied by the American constraints. But in some cases, ways were found to work around them. These constraints are interesting as they shed light on an important question in the history of science: How and why does knowledge circulate?[4] Several factors that specifically affect the mobility of information have been identified before in the context of an early joint nuclear reactor project between the Netherlands and Norway. Knowledge was traded against strategic materials (such as uranium in the Netherlands or heavy water in Norway), and was transferred between scientists as well as being regulated because of national interests.[5]

In this article, I will argue that a broader framework to consider knowledge circulation in relation to state security is important. First, I will consider how classification and declassification can be seen as two sides of the same coin and how officials in the US struggled with this. A second point concerns the selective spread of disinformation and information—to make the former credible—through intelligence networks. In this way secrecy was used as an intelligence tool in the early Cold War. I will examine both points in the specific context of the Dutch-Norwegian nuclear collaboration.

The US debate on classification and declassification initially resulted in strong secrecy measures, when in August 1946, the extremely restrictive Atomic Energy Act was adopted by the US Congress. The American nuclear monopoly lasted only four years until the first Soviet nuclear weapon test in August 1949. This led to the declassification of some nuclear information but was only one of several events that moved the perimeter of nuclear secrecy.

The formal restrictions of the Atomic Energy Act of 1946 were not relaxed until President Eisenhower's Atoms for Peace program, announced to the United Nations in December 1953. This led to an amended Atomic Energy Act in August 1954. By this time, the initial postwar situation had changed dramatically. In response to the Soviet nuclear test the US had developed its "super" hydrogen bomb resulting in several technically successful bomb tests that were up to a thousand times more powerful than the wartime atomic bombs. By the summer of 1953, the Soviet Union in turn had tested a significant thermonuclear weapon, strengthening the atom's negative connotations of death and destruction. Atoms for Peace attempted to change that notion. All in all, it was a multipurpose initiative to dispel the militaristic image of the atomic energy, but at the same time strengthen the military supremacy of the United States and to open the commercial development of nuclear energy by relaxing the most stifling restrictions from the Atomic Energy Act.

Between the end of the War and the Eisenhower's Atoms for Peace announcement in December 1953, the US, UK, and Canada organized six nuclear declassification conferences, starting in November 1947.* In the second conference in September 1948, declassification officials contemplated the goals and limits of secrecy:

> Even perfect secrecy does not preserve a scientific fact for an indefinite time. Any scientifically competent potential enemy can acquire it by his own independent effort. Once he has made his own determination his direct progress does not depend on the data previously acquired by others. Continued secrecy

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* Joint declassification conferences continued after Atoms for Peace, at least until the ninth conference in 1958.

> then merely hampers the scientific progress of those who practice it and their friends.[6]

The same problem, that nuclear secrecy is fundamentally a two-sided issue, was identified by Margaret Gowing in her history of the British nuclear program. Gowing cites the Director of Classification of the United States Atomic Energy Commission (USAEC) who found that the "rock-bottom soul-searching question" was "whether seeking security through secrecy interferes with security by achievement."[7] How to weigh the security benefits of your own nuclear progress—enabled by a free exchange of information—against the benefits of slowing down your adversary? From the American perspective, keeping secrets and declassifying could thus both be seen as expressions of power, as these represented two sides of the same coin. Alex Wellerstein, in his history of nuclear secrecy in the US, observed that "secrecy and revelation are not only paired, but can serve many different ideological and institutional goals."[8] A similar point has been made by Krige.[9]

The possibilities for cooperation and the dilemmas that classification posed in the US, however, were not recognized as clearly in Europe as in the US. The overriding consideration in American (de)classification, maintaining the relative distance between the superpowers in the early Cold War arms race, was frequently overlooked in Europe, because of the asymmetric power relation in which the US and Europe operated. Independent European discoveries of nuclear knowledge and technology that were considered secret in the US can be seen as efforts to reduce that asymmetry.

But it was not until after the Soviet test in 1949 that the first programs in the small countries yielded tangible results. The end of the American nuclear weapon monopoly gave a major impulse in the US to rethink its strategy on secrecy. After the United States re-established its lead in the nuclear military field with a successful hydrogen bomb test in 1952, the time had come for a major revision of its nuclear classification policy, particularly concerning "modest" (civilian) nuclear application. This roughly coincided with some independent nuclear initiatives in Europe. These include the establishment of a Dutch-Norwegian nuclear reactor (1951), the development of a Dutch uranium enrichment device (a calutron* in 1953), and, by 1960, developments in the Netherlands, West Germany and the UK on ultracentrifuges for industrial uranium enrichment. The United States requested that further research in these countries should be classified as per American classification guidelines, to which they agreed. Scientists and diplomats in Europe were now positioned within the boundary of American secrecy.

The central question in this article is: what does the shifting boundary of secrecy tell us about actual and perceived power relations? A related question is: to what

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* A contraction of 'California University cyclotron'. These machines were developed and employed on a massive industrial scale to enrich uranium in the Manhattan Project.

extent was classification in the US and UK effective in preventing the development of nuclear programs in the Netherlands and Norway? The changing scope of secrecy traces the changing power relation between science in the United States and some of the countries in Europe.

Desperately Seeking Science—A Reactor and a Calutron

After World War II, the UK was the first Western country to embark on a major nuclear program, continuing its work as a former Manhattan Project partner, but now cut off from US cooperation by the August 1946 Atomic Energy Act. French scientists had played an important part in the construction of a small heavy water reactor in Canada that went critical in September 1945. Even though the US also cut its ties with its French partners immediately after the war, the French nuclear program could build on its wartime experience, resulting in the completion of a small reactor in France similar to the Canadian one in December 1948.

In the early days of the American nuclear weapon monopoly almost all nuclear technology was perceived in light of its military potential. Even a proposal for the export of a harmless isotope (Fe-59) to Norway in the late 1940s was successfully countered.[10] From a military perspective, the single most important feature of nuclear technology is the production of fissile materials: weapons-grade uranium or plutonium. To qualify as weapons-grade, uranium should be enriched to about 90% in the isotope U-235 whereas natural uranium contains about 0.7% U-235.* Weapons-grade plutonium should contain at least 93% of the isotope Pu-239. Plutonium is produced in reactors through the transmutation of U-238 at a rate of about one gram per megawatt-day.**

Even small reactors, that did not have sufficient power to produce weapon-relevant quantities of plutonium in a reasonable time, or calutrons that produced milligrams of enriched uranium, were considered sensitive technologies squarely within the secret domain. Both trajectories to nuclear fission weapons in the Manhattan Project, that of highly enriched uranium and weapons-grade plutonium, had started small.[11] Also, in the UK and France, small research reactors were constructed before the larger plutonium production reactors were built.

For the smaller countries in Europe, such as the Netherlands and the Scandinavian countries, gaining access to new developments in science depended critically on two things: access to nuclear materials and their ability to liaise with colleagues abroad.[12] The very first postwar steps were often taken by scientists

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* Typical weapons-grade uranium contains about 93% U-235 although the first atomic bomb used on Hiroshima contained only about 80% enriched uranium.

** To produce the roughly six kilograms of plutonium in the atomic bomb on Nagasaki, about 6,000 megawatt-days of reactor energy output are required. A 100 megawatt reactor would produce this amount in sixty days, whereas a one megawatt reactor would have to run continuously for 6,000 days.

who had developed an international network before the war. In the Netherlands, theoretical physicist Hendrik Kramers played a central role, together with the young physicist Jacob Kistemaker. Kramers was at that time the Netherlands' most prominent theoretical physicist, the successor of Paul Ehrenfest in Leiden and former assistant to Niels Bohr. In Norway, the astrophysicist Gunnar Randers took the initiative to develop a small nuclear program.[13] These initiatives were partly motivated by the strategic nuclear materials these countries possessed: Norway controlled the only heavy water production facility in the world outside North America. Norway had started the industrial production of heavy water as a byproduct of its fertilizer industry already before the war. The Netherlands had, due to the foresight of Leiden physicist Wander de Haas, quietly ordered ten tons of uranium oxide that was hidden during the war.[14] Heavy water is an excellent moderator to use for a small research reactor, the kind that Randers was to realize in Norway.

The Norwegian Reactor

Randers had worked on astrophysics in the US before the war where he had built an excellent network. Early in the war, he was working in Chicago in the same building where Enrico Fermi was building his first reactor. A few months before the reactor went critical in 1942, he relocated to the UK to join efforts to liberate Norway. In the UK, he was shown the classified patents of Frédéric Joliot-Curie on heavy water reactors which primed his thinking on the possibility of a (Norwegian) reactor. After the war and back in Norway, Randers learned from the Smyth Report that some of his former acquaintances in the US had worked on the Manhattan Project. Together with Norwegian engineer Odd Dahl, he set out on a trip to the US in July 1946 to gather as much information as he could for a Norwegian reactor.[15] Randers and Dahl made optimal use of their pre-war personal contacts noting that security measures "were not so strict that personal contacts could not provide access."[16] They interviewed a score of Manhattan Project veterans and visited many of the major universities. Most importantly, they were able to sit down with some of the reactor designers such as Fermi and Walter Zinn. The information they acquired confirmed that a reactor could be built with modest amounts of heavy water and uranium. But for Randers and Dahl their goal was not only to get information, they also had a message for the Americans. As Dahl recounts in his 1981 biography:

> For us it was not just about gaining knowledge, we were also out to tell the Americans that *we planned to break their atomic monopoly and point out how much we already knew*. For the American side I thought the meetings were both important and informative, because it became very clear to them that Randers possessed more knowledge than was foreseen by the system.[17]

Upon their return to Norway, the reactor project formally started in a small town called Kjeller, close to Lillestrøm. Randers tried to exchange heavy water for uranium with the US, the UK, and France but without success. He did manage to get useful reactor design information from French colleagues in return for heavy water. He even received fifty tons of French reflector graphite that was put around the Norwegian reactor to increase its neutron economy.[18] By early 1950, with the reactor nearly finished, Randers grew desperate as even Norwegian ore had proved insufficiently rich in uranium. At this point, Kramers in the Netherlands proved instrumental to forge a breakthrough. In January 1950, he had travelled to Norway to explore opportunities for nuclear collaboration. He had ten tons of prewar uranium oxide to bring to the table, a huge surprise to Norway. Both men quickly realized the unique potential of a collaboration to which they agreed on the spot and that was formalized shortly thereafter.[19] In July 1951, Norway and the Netherlands started the operation of their joint research reactor called JEEP: the Joint Establishment Experimental Pile.

At this time, in 1951, most reactor design information was still officially classified in the US. But by 1950 several developments had taken place that warranted declassification in the US for the smallest types of reactors. As Gowing sums up:

> The Russian bomb test did, however, prompt the relaxation which the British wanted most, that is, declassification of certain low-power reactors.… in early 1950 most features of all reactors were still secret. *Yet by this time the Russians clearly had a production reactor, the French had a low-power reactor, and Norway was about to build a small pile.*[20]

The relative magnitude of the problem of independent nuclear development is reflected in the order of events given by Gowing: Russian development of a (plutonium) production reactor for nuclear weapons was clearly the largest problem from the American point of view, followed at some distance by developments in France (low-power reactor) and Norway (building a small research reactor). At the same time, it ranks the importance with respect to declassification. A similar comment about the pressure on the American secrecy regime in the early 1950s was made by Bertrand Goldschmidt, a French Manhattan Project veteran, in his 1982 memoirs:

> The British accession to nuclear arms in 1952, the Russian thermonuclear explosion the following year, and, less spectacular but nevertheless significant, the first French and even Scandinavian civil atomic achievements together provided final confirmation of the failure of the secrecy policy.[21]

The developments in France and Norway were discussed at the Fourth Declassification Conference in Harwell, England, from 9–12 February 1950. It was decided to wholly declassify low-power research reactors. This was at least partly motivated by the Norwegian research reactor, the development of which was seen as a problem by declassification officials:

> The completion of the French and the building of the Norwegian heavy water research reactors has given rise to an international problem. If it is decided to release CP-3 in its entirety, this problem will disappear almost entirely.[22]

CP-3 was the world's first heavy water reactor completed in Chicago under the Manhattan Project in 1944. It had inspired the design of the Canadian zero-power reactor ZEEP in 1945, which in turn had inspired the French and the Norwegian reactor designs. Possibly, the quoted international problem was that because of classification, the French and Norwegian reactor programs were by necessity disconnected from the American program. This stood in the way of formal collaboration. That problem could be addressed, and solved at least partly, by declassifying CP-3. As declassification officials had noted earlier: "continued secrecy merely hampers the scientific progress of those who practice it and their friends."[6]

The Dutch Calutron

In the Netherlands, the uranium that was contributed to the Dutch-Norwegian reactor was initially destined for experiments in enrichment. The development of uranium enrichment in the Netherlands owes much to one man: Jacob "Jaap" Kistemaker. He studied astronomy and physics in Leiden and completed a doctoral degree in physics in November 1945 at the famous low-temperature Kamerlingh Onnes Laboratory in Leiden. Hendrik Kramers acted as his supervisor. When the Smyth Report came to Kramers in October 1945, he passed it on to Kistemaker who could only have it for twenty-four hours, before having to pass it on to the next Dutch reader. Kistemaker read the entire report through the night and was electrified by what he read. As he recalled in 1991:

> The information in this booklet has sparked a chain reaction in the brain of various European physicists. We have been set back terribly regarding knowledge and technology. For some, this caused them to move across the ocean as fast as possible. For others, on the contrary, *it was a great challenge to break the imposed secrecy regarding everything that had to do with atomic nuclei.*[23]

This comment is like that by Odd Dahl quoted above about "breaking America's atomic monopoly." Kistemaker did not see imposed secrecy as a nuisance or simply a given but as a great challenge. In the meantime, Kramers had become chair of the Dutch committee for nuclear physics, a committee that wanted to send someone to Niels Bohr in Copenhagen to get acquainted with the new physics. The committee decided to send Kistemaker to Bohr, where he started in January 1946.

In Copenhagen, Kistemaker energetically threw himself into this new field. He worked with Jørgen Koch who had built a small electromagnetic separator, a calutron. Young and impatient, Kistemaker was eager to master the secrets of the calutron fast, whether by his own efforts or through his contacts. Together with Koch, he wrote a letter to Ernest Lawrence in the US to ask whether "anything about these sources could already be released."[24] Lawrence replied that the calutron was one of the Manhattan Project's most secret parts.[25]

After his stay in Denmark, Kistemaker returned to the Netherlands and started work on electromagnetic isotope separation at the Zeeman laboratory in Amsterdam in January 1947. The idea behind the electromagnetic separator is simple: ionized isotopes moving through a magnetic field will have slightly different trajectories due to their mass differences. Heavier isotopes will be slightly less deflected than light isotopes. As is often the case, to put these principles into practice was very much harder than the underlying theory. Major problems concerned the constantly recurring spontaneous discharges of the high voltage (thirty kilovolt) source but also the production of the magnets (figure 2).[26]

Finishing the separator still required several years of work, however, with the ion source proving to be particularly difficult to get under control. But by early 1953, a workable solution was found. The high-voltage graphite ion source was outfitted with stainless steel caps that had a special curvature, so-called "anti-corona caps," that prevented discharges. When in February 1953 a large part of the calutron technology was declassified in the US, the anti-corona caps were kept classified.[27] These caps were a specific piece of calutron hardware that had been especially hard to master. By keeping its design details secret, the proliferation of the calutron could be controlled or at least delayed, controlling this particular path to the production of enriched uranium.

In March, Kistemaker made a trip to Harwell in the UK and was allowed to study details of the separator there. By then many details of the calutron had been declassified in the US, and he noted many design and operating details of the device.[28] The anti-screening caps were still classified in the UK and US, but Kistemaker was able to see the caps on the older English small test separator. As he noted in the report of his trip, this instrument had been made independently by Harwell and was therefore not subject to American classification. He noted that the screening caps had a larger distance to the source than in the Netherlands and had a corrugated model, confirming his own design of corrugated screening caps (figure 1).[29] Another kind of confirmation of his own design came when, during the same period, an American visitor came to the laboratory in Amsterdam. Upon seeing the curved caps—known in the American program under the code name "Mae West"—the visitor remarked: "Ah, you found it."[30,31]

By the summer of 1953, the separator produced the first enrichment of uranium, one of the original goals of its construction. Between July and October, a first test run yielded a uranium sample with an enrichment of 8.5% U-235 (containing a

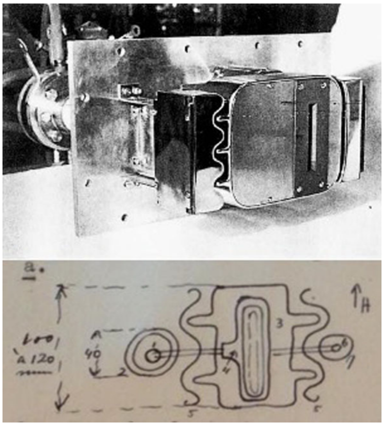

Fig. 1. The curved anti-corona caps to prevent spontaneous high-voltage discharges of the ion source in the Dutch mass spectrometer (above). *Source*: Impact—60 years AMOLF, p. 16. Kistemaker's drawing of the caps of the old, independently developed, Harwell separator (below). *Source*: AMOLF—FOM reports

total of 0.8 mg of U-235). In the next separation run that lasted 9.5 h a larger sample was produced that contained 1.6 mg of U-235 with an isotopic purity somewhat superior to the test sample.[32] This second sample was immediately sent to Kjeller in Norway, as intended, where it was used to measure the cross section for fission of U-235 as a function of the incident neutron energy.[33] These data were still classified in the US.

On November 6, Kistemaker proudly presented the very first test sample of ten milligrams of uranium with an enrichment level of 8.5%, to the board of the institute for Fundamental Research on Matter (FOM) (figure 2).[34,35]

Fig. 2. Kistemaker (left) presents the first sample of enriched uranium to the board of FOM. The large separator magnet is seen in the background. *Source*: Impact—60 years AMOLF, p. 16

Kistemaker claimed that the United States was forced to reveal details of the installations for producing uranium-235 in March 1953 under the pressure of scientific progress made in Amsterdam: "Dutch knowledge and perseverance can thus be said to have made a great contribution to progress in the free world."[36] In May 1955, he gave a talk at Oak Ridge National Laboratory on "how to build a calutron." According to Kistemaker, Alvin Weinberg came up to him after the lecture, shook his hand and said: "This is the end of classification." Similarly, an early administrative history of the enrichment program in the FOM 1959 annual report states:

> The electromagnetic isotope separator was built almost completely independently of English and American data as the first facility of this kind in the free world not bound by secrecy. One of the results has been that, one year after the completion of this so called calutron, the data of facilities built in the USA and England were released.[37]

On the Dutch side, it was strongly felt that its independently produced machine had forced the Americans to give up the classification of information about the calutron. But Kistemaker overestimated the impact of this first enriched uranium. Already shortly after the first Russian nuclear test, declassification officials from the US, UK, and Canada noted in the secret minutes of the February 1950 declassification conference:

> The Russians have probably separated milligrams of U 235.… We can now assume that there is no longer any special security attaching to milligram quantities of fissionable material *per se*.[38]

Russia clearly was the main concern here. When John Cockcroft at Harwell received word of the enriched sample in Amsterdam, he guessed correctly that the Dutch method was based on electromagnetic separation. According to Cockcroft, the output in the order of milligrams was "of no interest to us."[39]

Nuclear Confidence

The reactor in Kjeller and the calutron in Amsterdam provided ways to produce small quantities of plutonium and enriched uranium, respectively. But is also gave Dutch and Norwegian scientists growing self-confidence. With the development of such nuclear capabilities outside the US and UK, it was inevitable that some of the fundamental data on fissile materials that were classified in the US would be independently established abroad. One such bit of information concerned the probability that a U-235 nucleus would split as a function of the energy of slow incoming neutrons. In the US, this probability—the "cross section"—had only

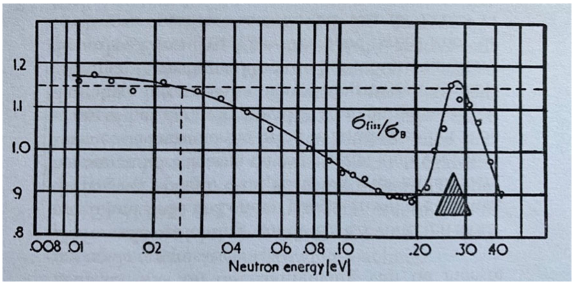

Fig. 3. Dependence of the fission cross section for U-235 as a function of incident neutron energy, with a resonance at around 0.28 electron-volts. The plot shows the ratio of the fission cross section of U-235 to the neutron absorption cross section of B-10. The latter is inversely proportional to the neutron velocity. *Source*: JENER third annual report 1953/54

been published for one particular value of the neutron energy.* The result for other energies remained classified in the US and UK because of its “considerable” interest in the design of “new power piles.”[40,41]

The concern here was that the variation of the fission cross section could help foreign scientists with the construction of nuclear reactors at higher power than small research reactors. While small research reactors were used for training purposes, high power reactors had the potential to breed significant quantities of weapons-grade plutonium.** Declassification officials clearly believed that keeping fundamental physics data secret could prevent or slow down foreign scientists in their (military) nuclear development.

In Kjeller, Norway, the Yugoslav physicist Dragoslav Popovic was working on exactly this fission cross section problem. When the first enriched uranium from Amsterdam arrived in late 1953, he performed a measurement of the classified domain that confirmed a non-trivial dependence of cross section against incident neutron energy (figure 3).[42] Popovic thanked Kistemaker in his published article “for providing the U-235 for the measurements.”[43] He presented his results at the nuclear physics conference in Ann Arbor, Michigan, the following year. One of the Dutch participants, Teun Barendregt, recalled in 1991 the strong impression that Popovic made with his results:

> I remember the consternation with the Americans, it was after all classified. The measurement was performed in Kjeller, earlier than in France.[44]

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* For thermal neutrons (average speeds 2,200 m per second or 0.025 electron-volts), a value of 545 barns for the fission cross section of U-235 was published. See RDD-8, p. B-1.

** A higher power is needed to produce weapon relevant quantities (kilograms) of plutonium within a reasonable time. A rule of thumb is that a reactor produces roughly one gram of Pu-239 per megawatt-day. A megawatt-day is the amount of thermal energy generated by a reactor that operates at a power level of one megawatt for a period of twenty-four hours.

French physicists also published a result using natural uranium a bit later and shortly thereafter obtained a “substantial improvement” of their result when they measured the variation of the cross section of uranium with enriched material from Amsterdam.[34] Their results agreed with those obtained by Popovic in Kjeller.[45]

The scientists working in the Dutch-Norwegian collaboration saw their result as something of a triumph. Not only were they able to independently establish fundamental physical information that was still classified in the US, they also preceded French scientists who were widely seen as having the most advanced nuclear program in continental Europe. One of the Dutch physicists working in Kjeller at the time, Jaap Goedkoop, commented:

> The publication of this [these results] in early 1954 has undoubtedly contributed to the declassification of the cross section of fissile elements in the following years.[46]

This claim, however, that this kind of independent research “undoubtedly contributed” to declassification, should be doubted. The declassification as of 1954 referred by Goedkoop came under the Atoms for Peace Program and the changes in the Atomic Energy Act of 1954. But Atoms for Peace and the declassification it brought were a response to changes in the international world order since World War II. It would be wrong to conclude that results as those of Popovic were one direct cause for declassification. Ideas for large scale declassification were in the air already. In the declassification conference of April 1953, the US delegation suggested significant declassification as “a departure of past procedures”:

> by making a large body of classified reactor data available without the stringent security requirements required for ‘restricted data’. It was envisaged that the security standards applied to such data ... would permit exchange of information between the A.E.C. and the U.K. and other Western European projects. Such a change would require amendment to the U.S. Atomic Energy (McMahon) Act.[47]

The reference to ‘other Western European projects’ would have included the Dutch-Norwegian program, as together with the French program it was the only operational reactor project in Western Europe at that time. Declassification officials were aware of the risk that continued secrecy could hamper their own progress.

Finally, it is telling that Popovic’s result was published the next year (1954) in the opening article of the first issue of the newly founded *Journal for Nuclear Energy*. This journal had an editorial board that reflected the new international atomic landscape. Gunnar Randers was one of the assistant editors, and there were advisory editors from France, Switzerland, the Netherlands, Australia, Belgium, and of course the US and UK. In the opening editorial Cockcroft, one of the advisory editors, specifically alluded to the developing atomic projects around the

Fig. 4. Gunnar Randers (left) and Alvin Weinberg (right) at the 1953 conference in Kjeller, Norway. *Source*: The European Atomic Energy Society, 1954–2004

world as a *raison d'être* for the journal: "The formation of Atomic Energy projects in at least eight European countries has made it worthwhile to found a journal primarily for publication of technical articles from the staff of these projects and their associated industrial groups."[48] The fact that Cockcroft, together with the British and American editors, put the result of Popovic so visibly in their journal does not suggest any shock about this result. It was clear that the nuclear landscape had changed, and small peaceful nuclear programs were starting to develop around the world.

First Heavy Water Reactor Conference

In the runup to Atoms for Peace, there were more signs that secrecy was being challenged by scientific developments in Europe. One such sign was a rather remarkable conference that was organized by the Dutch-Norwegian Joint Establishment for Nuclear Energy Research (JENER) in August 1953—the first international conference on heavy water reactors. It was held in Norway and attracted a varied and highly interested global audience. Cockcroft referred to it as the "first unclassified International Reactor Conference."[49] No fewer than eighteen different countries were represented, including countries such as Argentina and Brazil, Israel, and India. The US sent a delegation that included Alvin Weinberg from Oak Ridge National Laboratory (figure 4).[50]

Weinberg and his American colleagues tried to make a significant contribution to the conference "within the bounds of security."[51] These bounds of security had been somewhat relaxed as the USAEC had "declassified performance information on the Material Testing Reactor in Oak Ridge, a film about the Homogeneous Reactor Experiment, and data on the new Argonne research reactor especially for presentation at the Oslo meeting."[52] This illustrates how the conference itself caused some information to be declassified by the United States. Nonetheless, as British delegate John Dunworth reported in a confidential trip report: "Weinberg is extremely cautious from a security point of view and was absolutely horrified by the large amount of U.S.A.E.C. information in possession of European countries."[53]

At the end of the conference, Randers proposed a plan to create a European Atomic Energy Society (EAES).[54] Such an initiative was typical of the self confidence that was emerging in the participating countries. Its main aims were to share information and build a network between scientists of different member states. According to French Manhattan Project veteran Goldschmidt, "the society played a noteworthy part in breaking down the psychological barriers that were the legacy of 15 years of secrecy."[55]

But at the same time there were military nuclear developments taking place elsewhere. Unbeknownst to the conference participants, the Soviet Union tested its first thermonuclear weapon—RDS-6—on the second day of their conference, August 12, 1953. The test, with an explosive yield of 400 kilotons, was not a megaton-range radiation implosion device like the one the US had tested the previous year but still had 15–20% of its yield from fusion.[56] The test revived the discussion in America on the merits of nuclear secrecy and put the discussion of small reactor development in third countries into a different (thermonuclear) light. The Soviet test would undo "operation Candor," an idea by the Eisenhower administration to provide more information to the American public about the arms race.[57] But in searching for other possibilities for openness the AEC concluded in favor of a greater release of technical information. "Since the Soviets already had the bomb, the largest impetus for constraining information had been relieved."[57]

It is reasonable to expect that the goal of classification, which initially was to protect the American nuclear weapon monopoly, had to shift once that monopoly was broken. This was explicitly acknowledged in the fourth US/UK/Canadian declassification conference in February 1950. The first Soviet nuclear test had happened, and atomic spy Klaus Fuchs had been arrested. The basic assumptions concerning the Russian program were revised and now included a statement on the relative potential of the Western military nuclear programs:

> Our security policy must still be directed to achieving the maximum military potential *relative to* Russia in the field of atomic energy. It could be assumed that with respect to other countries our *relative* potential in the field of atomic energy is sufficiently large so that they do not constitute a threat to our national security.[58]

A similar observation has been made by Alex Wellerstein in his history of nuclear secrecy in the United States:

> They [early reactor and electromagnetic enrichment technologies] were "primitive" technologies, after all, the sort that any advanced nation could pursue, and a decade out of date. In a bipolar Cold War world, the boundary between "safe" and "dangerous" technology had been redefined as a relative

> one: the difference in advancement between the USSR and the US. Technologies that made no difference in that relative distance were no longer "dangerous", even if they could still be used to produce bombs.[59]

The Dutch calutron and the JEEP reactor are two examples that confirm that these "primitive" technologies could be realized by advanced nations, even small nations such as the Netherlands and Norway. So, it was not the independent discovery of nuclear technologies and data per se that prompted declassification, as it was believed in the small countries where this was done, as their results no longer mattered to the relative distance between the two superpowers.

Heavy Water to Israel

As the 1953 heavy water conference made plain, many countries were interested in developing their own nuclear programs. Israel was one of them. It sent a four-man delegation to the conference that included three members of the recently-founded Israeli Atomic Energy Commission (IAEC). The IAEC, created in the spring of 1952, has been held to have been a secret organization for the first two years of its existence.[60,61] Some of its scientists, however, participated under this affiliation in the Norwegian conference. One of them was Israel Dostrovsky who would later play a major role in Israel's military nuclear program. According to Norwegian research journalist Odd Karsten Tveit, IAEC's head Ernst David Bergmann and Israel's ambassador to Norway visited Randers the day after the conference, on 14 August.[62] Bergmann asked Randers if it were conceivable that in the future Norway might trade heavy water against uranium mined in Israel. Israeli scientists were working on novel ways to produce uranium and Bergmann was confident they could produce it in the foreseeable future by the ton. After three hours they agreed on nuclear cooperation between the two countries.[62]

Bergmann also approached French contacts to explore nuclear cooperation options. By the end of 1953, several Israeli scientists were able to work in the French research centers in Saclay and in Chatillon to study reactor physics.[63] This arrangement was similar to that with Norway, when Norwegian scientists had worked in Chatillon in the years before their reactor was being developed. In parallel to the reactor negotiations, Israeli scientists had worked to secure heavy water for the reactor. Israel had attempted to acquire heavy water from the US, but the US insisted on safeguards to ensure peaceful use of the heavy water, something the Israeli government resisted. So, in August 1956, Bergmann approached Randers again, now asking for ten tons of heavy water, to be delivered in the year 1960.[64]

In the course of 1958, negotiations took place for twenty-five tons of heavy water to be delivered to Israel through NORATOM, the Norwegian company created to promote Norway's nuclear industry,[65] with Randers as one of the board members. Norsk Hydro, the company that produced the heavy water had been reluctant to sell to Israel since it was selling other products to Egypt and did not want to risk this part of its business. NORATOM found a way to bypass this problem, however, by buying back a quantity of twenty tons of heavy water that had been sold to the United Kingdom that no longer needed it. The idea was that the heavy water would go straight from the UK to Israel without going back to Norway in order to cover up the fact that it was Norway selling the heavy water. The UK Atomic Energy Authority (UKAEA) was willing to go along with the idea and considered it "as somewhat unreasonable that we should now stipulate for conditions we did not accept ourselves."[66] Diplomats in the UK agreed to the sale but decided not to inform their US counterparts. As British diplomat Donald Cape noted: "I would prefer not to tell the Americans lest it lead them to ask us to take up what would in fact be an untenable position vis-a-vis the Norwegians."[67] In the UKAEA it was felt that "it would be primarily for [the Norwegians] to consider the issue … It would be somewhat over-zealous of us to insist on safeguards."[67]

The Norwegian government indeed insisted on safeguards, and these initially appeared to be unacceptable to Israel. So, Randers engaged in new talks and in the end, Israel agreed to a limited form of safeguards that allowed Norway to verify the presence of heavy water outside the reactor, but not inside the plant itself.[68] On February 29, 1959, an agreement was reached between Israeli minister Chaim Yahil and Halvard Lange, Norway's minister of foreign affairs. Furthermore, Israeli officials promised to use the heavy water only for peaceful purposes and under these conditions the heavy water was shipped from Britain to Israel.

A growing nuclear self confidence in Europe paired with frustration about the US's limiting nuclear politics helped Norway and Britain to secretly cooperate in a deal to sell heavy water. The accompanying safeguards were minimal while scientists and diplomats in the US were mostly kept out of the loop. The sale put Israel in a position to construct a plutonium producing reactor, something American policy makers had wanted to prevent. On June 5, 1959, Norwegian foreign ministry official Olaf Solli confided the heavy water sale to William Fullerton of the USAEC.[69] This information was, however, not shared with the American intelligence community until the end of 1960.[70] The frustration among intelligence officials of having missed several key steps in the process is evident in an assessment that was prepared in January 1960 by the US Joint Atomic Energy Intelligence Committee: "Information on Israeli heavy water procurement available in the US Government as early as June 1959, but not disseminated to intelligence, would have confirmed the existence of an additional reactor construction program in Israel."[71] This frustration may have been compounded by the fact that the CIA had been involved in a multilateral nuclear intelligence operation in Norway between 1953 and 1960, which is the subject of the final section of this article. The CIA worked closely with Randers but missed the heavy water sale.

By 1960, the heavy water deal was finalized, and little could be done to reverse it. At the same time, however, another development caught the attention of nuclear policy makers in the US, which concerned the large-scale production of the other fissile material, enriched uranium, in Europe. This raised new questions on the boundary of secrecy.

Ultracentrifuges (1954–60)

Nuclear achievements discussed so far—reactor, calutron, and fundamental data—had already been developed within the Manhattan Project. By 1950, enrichment of uranium in the West had only been developed on an industrial scale in the United States and was focused on gaseous diffusion. Britain followed with the same method for low enriched uranium in 1953 and highly enriched uranium by 1954.[72] The gaseous diffusion plants were industrial installations that consumed enormous amounts of energy but delivered the required enriched uranium. They took away the need for alternative technologies, such as centrifuge enrichment. For other countries that had not invested in this expensive technology, such as Germany and the Netherlands, it was worthwhile to explore the old centrifuge idea.

The idea of isotope separation by fast spinning centrifuges was first proposed by British physicists Frederick Lindemann and Francis Aston in 1919.[73] Jesse Beams at the University of Virginia was the first to successfully use centrifuges to separate isotopes of chlorine in 1934. The method was further explored in the Manhattan Project but abandoned for more effective methods. After the war, Beams continued working on the method until 1951 when centrifuge research was terminated on advice of the US Atomic Energy Commission.[74] Meanwhile, in Germany, ultracentrifuge research had begun during the war and was thereafter continued. As of 1945, German enrichment research proceeded in Hamburg, where Paul Harteck and Wilhelm Groth explored different separation methods, including centrifuge enrichment.[75]

In November 1954 Kistemaker, looking for ways to improve enrichment techniques beyond the small calutron, went to Germany. Through a chance encounter at a colloquium in Hamburg he heard a talk by Hermann Gerhard Hertz on centrifuges.[76] He was impressed by what he heard.[77] This information led to a reappraisal of the Dutch enrichment efforts with calutrons—as discussed above—and the decision was made to start with centrifuges. Following the German lead, the first Dutch centrifuges were heavy machines, spinning horizontally on ball bearings, leading to significant energy losses due to friction when operating. The next step in centrifuge development came a few years later and, contrary to many other nuclear developments, came from the East rather than the West.

As of 1946, a significant research and development effort was conducted in Suchumi, on the shores of the Black Sea, led by German physicist Max Steenbeck.[78] The group of around sixty researchers consisted of both Soviet and German scientists. The latter had been taken out of Germany in an operation similar to the US Alsos Mission.[79] The experimental division was led by an Austrian, Gernot Zippe. Their approach was different from that in the West. The group in Suchumi worked on light vertical centrifuges on a pin bearing, as opposed to heavy horizontal machines in Germany. In 1953, however, Zippe stopped working on the centrifuge and was, together with his German colleagues, kept away from the project for two years. In 1956, Zippe, Steenbeck, and their colleagues were finally released from Soviet labor and were allowed to return home.

Zippe proved to be particularly successful in sharing his knowledge. He returned to Vienna upon his release where he began establishing contact with various Western partners. He was alerted to a symposium in April 1957 in Amsterdam, organized by Kistemaker. Although Kistemaker had invited all the major players he was disappointed that no Russians participated. When Zippe, who was completely unknown to Kistemaker, applied he was politely turned down.[80]

Zippe was unimpressed by this rejection and travelled by motorcycle from Vienna to Amsterdam to attend anyway. He learned to his astonishment that the work he had done in the Soviet Union far exceeded the accomplishments in the West. At the end of the symposium, he approached Kistemaker and asked for a private interview.[81] In a two-hour conversation on Saturday, April 28, he explained to Kistemaker what he knew. The effect on the Dutch project was immediate and dramatic. The next Monday, April 30, it was decided to change from heavy horizontal machines on slide bearings, to vertical machines: “light, elastic and self-aligning, with magnetic and pivotal bearings, almost floating.”[82] Zippe returned to Vienna and Kistemaker travelled there in June to meet him again. By that time, however, Zippe had made agreements with the German firm Degussa to develop a centrifuge and could no longer share information with Kistemaker. What turned out to be a very narrow window of opportunity made all the difference for the development of the ultracentrifuge program in the Netherlands.

The conversation between Zippe and Kistemaker is an interesting example of how sensitive knowledge could move, in this case—atypically—from East to West. Zippe, as a principal contributor to the knowledge of the Soviet centrifuge program had been released from the Soviet Union and felt free to share his knowledge in the West. What Zippe shared with Kistemaker fell on particularly fertile ground given the latter’s experience with enrichment.

Even though their conversation was short, a hand drawn note by Kistemaker from the conversation shows that he immediately grasped the most essential elements of what would prove to be a far superior centrifuge.[82] These include the pivot bearing but also the introduction of “bellows,” flexible joints that were inserted between different parts of the centrifuge rotor (tube). If a centrifuge is spun to high frequency, it will at some point encounter resonance frequencies that threaten to break it apart. Separating the long tube into several elements joined by flexible bellows both reduced the critical frequencies and provided extra flexibility to withstand these resonances.

By the spring of 1960, the Dutch program was showing the first signs of success. The Dutch were able to separate uranium isotopes and Kistemaker proudly sent a telegram to Groth in Germany: “We are separating uranium!”[83] In West Germany, progress had also been made. This combined progress worried the USAEC. Not until a “breakthrough” occurred did they want to disturb the relation with their allies.[84] But the time to act had come, one way or another.

The AEC considered imposing secrecy on the German and Dutch work. Could the US, however, ask foreign partners to adopt its classification scheme, and apply it to research that did not originate in the US? Other options were considered as well, including a radical proposal to declassify American results instead, as written in an AEC report on the gas centrifuge method:

> Finally, if agreement cannot be reached with the Germans and the Dutch to control gas centrifuge information, then there may be serious question as to whether a real purpose would be served in classifying our own work. Should we, therefore, as a result of our inability to secure German and Dutch agreement to control centrifuge information, decide to declassify our own work; it would appear possible to work out an arrangement for unclassified technical exchange with the Germans and Dutch under the ambit of EURATOM ....[85]

So, two options were being considered by the Americans. The first and preferred option was to put controls on the Dutch and German programs. But there was a second option: declassify American centrifuge work and then work out an exchange agreement with Germany and the Netherlands. Finally, they chose the first option: collaboration under the safe cloak of secrecy. The AEC duly advised to amend “the classified bi-lateral with West Germany and the Netherlands to include full cooperation in this field with both nations on a classified basis.”[86]

In July 1960, a semi-official American AEC delegation that was travelling in Europe visited The Hague and requested a meeting with Kistemaker.[87,88] The American delegation handed over a copy of the American “Classification Guide for the Gas Centrifuge Program.” This two-page document summarized which parts of the Dutch centrifuge research should be classified according to the standards applied in the US.[89] It was a radical request that came unexpected and caused debates between Dutch scientists and their ministry of Foreign Affairs. Both understood the risk of proliferation and how secrecy could help to prevent it, but the American request raised concerns as well: It would be difficult to introduce secrecy in a community that was used to exchange information freely.[90] Kistemaker pointed out that neither the research organization FOM nor Dutch industry would welcome secrecy.[91] Furthermore, he was worried that secrecy would complicate cooperation with the German researchers. At the same time, foreign affairs officials wrestled with what they felt was unwelcome media attention: “Despite all attempts to reduce publicity, several articles were found again in this morning’s newspapers.”[92] After prolonged debates and various media leaks, however, scientists and diplomats in both Germany and the Netherlands agreed to the American request. On March 10, 1961, all Dutch and German centrifuge work was classified “secret” by their respective authorities.[93]

The difference between US and European perspectives on this matter is striking. While US scientists and diplomats carefully weighed several options and doubted whether they could export their secrecy guidelines, in Europe they were accepted as if there was not much choice. Looking back in 1998, Kistemaker expressed his frustration with the arrangement: "At the time America made the rules, you did not think about objecting. But it was of course ridiculous, these kinds of development cannot be kept secret. It gave us tremendous problems."[88]

Cold War Atoms—Secrecy and Intelligence at JENER

The preceding sections dealt with secrecy and its impact on nuclear science and scientists in the Netherlands and Norway. But there is another dimension of secrecy in the same context that is worth considering—the role of nuclear intelligence. As much as secrecy complicated the practice of science, it was used by the intelligence community as a tool in the Cold War struggle. Between 1953 and 1960, the Dutch-Norwegian collaboration was the site of a multilateral intelligence operation producing disinformation for the Soviet Union, enabled by secrecy.

The veracity of classified information is by its very nature hard to verify. This makes it an ideal source of disinformation and poses fundamental epistemological problems for the receiver of intelligence. Spies in the Manhattan Project provided highly classified information to the Soviet Union, but on the receiving side it was used cautiously out of fear that it might contain disinformation.[94] Such disinformation could send the Soviet nuclear weapons program down costly blind alleys or simply cause delays.

In the early Cold War, the Dutch-Norwegian Joint Establishment for Nuclear Energy Research (JENER) had a special position, both geographically and politically. Geographically, because Norway shared a border with the Soviet Union, politically, because although firmly within NATO, the Netherlands had a small but vital communist party. Its scientists had good connections with British and American scientists, but some would also maintain relations with Soviet scientists or diplomats. In May 1953, the American Central Intelligence Agency (CIA) inquired with the American mission in Oslo about JENER: "What percentage of the whole project and what specific parts or phases are considered classified? … is there any classification guide system employed; any declassification guide system …?"[95] Although the Dutch-Norwegian collaboration professed a complete nuclear openness to the outside world, some research was indeed considered classified in America and Britain. The reason behind the question is not stated but may be interpreted considering the multilateral intelligence operation that was about to start and would eventually include the CIA, British MI6, and the Dutch and Norwegian Intelligence services. Moreover, the operation would turn into a double spy operation when its intelligence agent was also recruited to work for the Russian military intelligence agency (GRU).

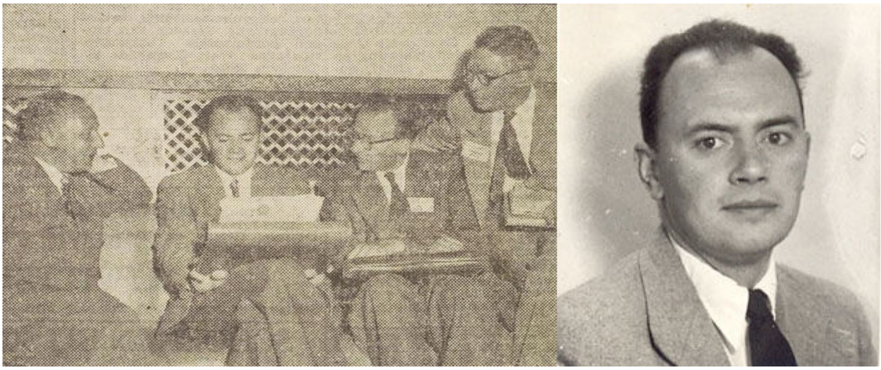

Fig. 5. Left: The Dutch delegation for the Atoms for Peace conference in Geneva in 1955. T. J. Barendregt is second from left. *Source*: Het Vrije Volk. On the right: T. J. Barendregt, 1950s. *Credit*: Courtesy of Cees Wiebes, personal archive

In their 1998 history of the Norwegian intelligence service, Norwegian authors Trond Bergh and Knut Einar Eriksen have pointed out that between 1953 and 1959 an operation had been conducted involving a Dutch double agent working in the JENER in Norway.[96] Apparently, this agent—code named “Tom”—worked for both Western and Soviet agencies. The operation was known in Norway as operation “Blåland” (Blueland). In 2016, new information was uncovered in the Netherlands by Dutch researcher Cees Wiebes, who managed to extract new material from the archives of the BVD (Binnenlandse Veiligheidsdienst or Domestic Security Service), the predecessor of the Dutch civil intelligence service.[97] Wiebes convincingly identified “Tom” as Dutch physicist T. J. (Teun) Barendregt (figure 5).[98,99]

Tom had already been recruited as an informant against Dutch communists for the BVD before 1950.[100] He worked in organic chemistry at the University of Utrecht and would become head of the chemistry department at JENER in 1953. In the Netherlands he played the role of a left-wing scientist, which gave him access to communist groups. Before moving to Norway to join JENER and still in the Netherlands, in February 1953, Tom was introduced by Joop Wolff, a member of the Dutch communist party, to a Soviet contact: Nikita Samokich, third secretary at the Russian embassy in the Netherlands.[101] Tom agreed to start providing information to Samokich, in fact to the Soviet military intelligence service GRU. He moved to Norway soon after, where he was one of the participants of the 1953 Heavy Water Reactor Conference. He would continue his work for the Dutch and Soviet services in Norway. Shortly after Tom had agreed to provide information to the Soviets, the head of the BVD, Louis Einthoven, decided to internationalize the operation.[102] In March and April 1953, Einthoven discussed Tom with his counterpart in the Norwegian Intelligence Service (NIS), Wilhelm Evang. They decided to run the operation together, and agreed to extend the cooperation to MI6 and the CIA. At least one reason to cooperate with the CIA was the fact that the BVD and NIS would not be able to provide sufficient credible disinformation.

Before the end of the year, five different intelligence agencies were involved in operation Tom, four from the West and one from the Soviet side.[102] In June 1954, the heads of the four Western services agreed that all the intelligence would be shared equally among them. The deception material, however, to be prepared by the CIA, was not to be shared with the other services. Here is another example of the asymmetric power field in which European countries operated with respect to the United States.

By late 1954 the Soviet GRU operative requested that Tom photograph secret documents concerning the tracking and analysis of a nuclear explosion. They specifically asked if he knew anything of the casing of an American hydrogen bomb that had been tested, possibly the Castle series conducted in March and April.[101] The Soviet question appears to refer to the casing in which the thermonuclear secondary is held that contains the fusion material. If this is made of fissionable material such as U-238, which can fission when exposed to highly energetic fusion neutrons, it can roughly double the pure fusion yield of a hydrogen bomb. These questions to Tom provided some insight into the Soviet level of knowledge and could be used by Western intelligence services to assess Soviet priorities.

Tom was a respected member of the Dutch-Norwegian collaboration and in some cases, he was asked to represent the collaboration abroad on behalf of Norway, even though he was Dutch. He was a member of the Dutch delegation to the 1955 Geneva Conference on Peaceful Uses of Atomic Energy, held from August 8–25 (figure 5). He had also attended the 1955 Soviet Conference on Nuclear Energy from 30 June to 6 July in Moscow, this time as part of the Norwegian delegation. While there, he was contacted by his GRU liaison and whisked away for a dinner and meeting with his Soviet handlers.[101]

For Tom the problem of providing suitable disinformation persisted. To remain credible, he had to provide reliable and preferably verifiable information from time to time. By June 1956, the NIS gave permission for Tom to drop the Kjeller paper *Atomic Propulsion for Merchant Ships* in a dead letter box.[101] In Norway (codename “Redland”), Gunnar Randers (“Redman/3”) was aware of Tom’s work and now assisted in the production of disinformation. In 1956 it was decided that American deception material would first go to Randers and it would get a “Kjeller stamp” marking it as secret or confidential.[103] The existence of such a stamp shows that the work in Kjeller was in reality not exclusively open and unclassified, unlike the image that was promoted by Randers and others to the outside world.[104] Randers’s assistance in providing disinformation to the Soviets was a change of the earlier policy when the CIA had exclusively claimed the production of deception material. The change mirrors a shift in relations between the US and Europe that developed after Atoms for Peace and the changes in the Atomic Energy Act in 1954.

By late 1957, however, Tom complained about the low quality of disinformation. CIA headquarters agreed that he should get higher quality information, and decided he could pass on secret documents from the Atomic Energy Commission. The idea behind this was simple. The documents were on a list to be declassified by the AEC, but officials at the CIA agreed with the AEC that declassification would simply be postponed by six months.[101] By 1958, Tom increasingly showed signs of stress, and his spymasters grew increasingly critical of his functioning. The operation ended by 1960 when Barendregt (Tom) moved to Belgium to become head of the nuclear reprocessing facility Eurochemic.

The construction of the joint reactor had entailed support and/or information exchange to Norway and the Netherlands from the United States, United Kingdom, and France. Except for France, each of these countries was involved in operation Tom. From the Soviet side, the interest in JENER also extended beyond this intelligence operation. In early 1956, the Soviet Union offered Norway slightly enriched uranium in research reactor quantities.[101] Clearly, the Dutch-Norwegian nuclear collaboration was seen as more than just a nuisance or a threat to the existing nuclear status quo. It was also seen as a Cold War opportunity.

Conclusion

The events discussed in this article take the boundary of secrecy in early Cold War nuclear science as a site that brings power relations into focus. In the immediate postwar period, the United States aggressively pursued a policy of secrecy to defend its nuclear monopoly. As nuclear programs in the Netherlands and Norway matured, their relation to American secrecy evolved and developed through different phases. This started with requesting the US for classified information in 1946 and ended with being requested by the US to classify information in Europe by 1960. The initial boundary of secrecy established by the US was thus not static and emerges as site that renders power relations visible, specifically between the US and countries in Europe that started their own nuclear programs. These events have shown that the framework to consider knowledge circulation in relation to state security can be refined and broadened concerning two points.

The first point concerns the dilemma secrecy posed, which was recognized early on in America. American scientists and government officials involved in (de)-classification wondered from the beginning “whether seeking security through secrecy interferes with security by achievement.” To stimulate new achievements in nuclear physics, which could strengthen security, an open exchange of information was required. But this had to be carefully balanced with classification policies to protect particularly sensitive information.

The US could not prevent the sharing of significant nuclear information between scientists in the US and Europe, after European scientists re-established prewar contacts after the war. On a trip to Europe in the summer of 1953, before the Atoms for Peace initiative, Alvin Weinberg from Oak Ridge was horrified by the large amount of USAEC information in the possession of European countries. The availability of that information paralleled a growing nuclear self-confidence in Europe. One example of this was Norway's sale of twenty tons of heavy water to Israel in 1959 that was used in the latter's nuclear weapons program, where the US was mostly kept out of the loop. These initiatives confirmed the limitations of US attempts to control knowledge and materials. By 1960, developments in the Netherlands, Norway, and West Germany concerning uranium enrichment had progressed to such a degree that the US came asking for restraint and classification. By this time, power relations between the US and Europe had changed, effectively exporting American secrecy to Europe.

Yet, secrecy was perceived rather differently in Europe than in the US. The asymmetric power field between the US and Europe in the early Cold War is reflected in their asymmetric points of view on declassification. From the European perspective, the US hegemon dictated the boundary of secrecy leaving the smaller countries to fend for themselves. When policy officials in the US requested the classification of all centrifuge research in the UK, the Netherlands, and West Germany, they did so after careful consideration. In Europe, however, the request was perceived as a US power play that could not be resisted.

Nuclear research in the small countries did prompt some declassification in the US, UK, and Canada but on a smaller scale than Dutch or Norwegian scientists imagined. Dutch scientists generally overestimated the impact of their work on American secrecy. Declassification in America was primarily driven by weapon developments in the Soviet Union. It was not the independent establishment of nuclear technologies and data per se that prompted declassification, some data and technology simply no longer made much difference in the nuclear race between the two superpowers.

The second point concerns the use of secrecy as an intelligence tool in the early Cold War. A multilateral intelligence operation involving several Western intelligence agencies selectively spread disinformation in the Soviet Union. The fact that JENER was the site of such an intelligence operation between 1953 and 1960 shows that the program was closely followed in Britain, the United States, and the Soviet Union. The operation did influence (de)classification decisions but for different reasons than usual: formal declassification was delayed creating a pool of documents that could be harmlessly leaked. This classified information was genuine and by providing it together with disinformation it made the latter credible. So, classification was used as an intelligence instrument aimed to delay or mislead Soviet nuclear development and to solicit information about the status and interests of that program. A shift in power relations between the participating countries is visible during the time of the operation. Initially, the production of disinformation had been the exclusive domain of the US. But a few years later Randers in Norway was actively involved in producing disinformation as well. It is a sign that the Dutch-Norwegian nuclear project had matured to a level where it could autonomously produce credible “classified” nuclear disinformation.

The year 1960 roughly marks the end of a period in which individual scientists such as Randers and Kistemaker were able to personally influence nuclear policy in their home countries and abroad. Randers was given enormous liberties by government and industry, and used his extensive network to negotiate nuclear deals abroad. His influence indicates what an individual scientist could accomplish in Europe in the 1950s. Randers’s influence is somewhat comparable to that of Kistemaker in the Netherlands, who was able to use uranium and enrichment technology to trade knowledge and material throughout the same period. By 1960, their roles became constrained by new legislation, new secrecy policies and a political system that claimed control over further nuclear initiatives. The open world was bounded in new ways that reflected the new power relations between Europe and the US.

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Data availability All data are available in publicly available sources or, should this no longer be the case, a request can be made to the author.

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