Rolf Wideröe

Why is the Originator of the Science of Particle Accelerators so Neglected, Particularly in his Home Country?

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I. EDUCATIONAL BACKGROUND AND FIRST VOCATIONAL EXPERIENCE

Rolf Wideröe was born on 11 July 1902 in Oslo, Norway (Fig. 1). From an early age he exhibited a predilection for practical and theoretical engineering and science. Having passed his university entrance examination in 1920, Wideröe was in no doubt about where his future lay: he *had* to train as an engineer. In autumn the same year he was accepted by *Die Technische Universität* in Karlsruhe.

In the early 1920s, Germany was in the throes of rampant inflation and soaring unemployment. Wideröe experienced all this at first hand. In 1924, the young student provided a glimpse of his academic versatility when he wrote an extremely lucid article entitled '*Inflasjon-sanalyse*' [Analysis of Inflation], which was accepted for publication in a highly reputable journal (1).

Soon after enrolling at the university, and in addition to his compulsory subjects, Wideröe began to develop a simple yet ingenious theory. The idea was way ahead of its time and was a concrete indication that here was a clear-thinking, promising young scientist: Wideröe had postulated that it should be possible to apply the principle of an ordinary transformer to accelerate electrons to high energy by using a varying magnetic field, following injection into an evacuated, circular glass tube placed between two magnetic poles. To achieve this, a magnetic control field had to be adjusted to inter alia counterbalance the centrifugal force on the accelerated electrons.

Wideröe felt that he could not focus sufficiently on these 'extracurricular activities', but nevertheless managed to make a number of sketches of an accelerator based on this principle: an induction accelerator (Wideröe called it a 'radiation transformer') or betatron, as it was called in later scientific literature.

Wideröe graduated in 1924, specializing in high-voltage engineering. University had only served to strengthen his interest in electrotechnics. Thus, following a short stay in Norway, he returned to Germany to take a doctorate in this field. As proof that here was a mature, determined and independently minded graduate, he insisted on choosing

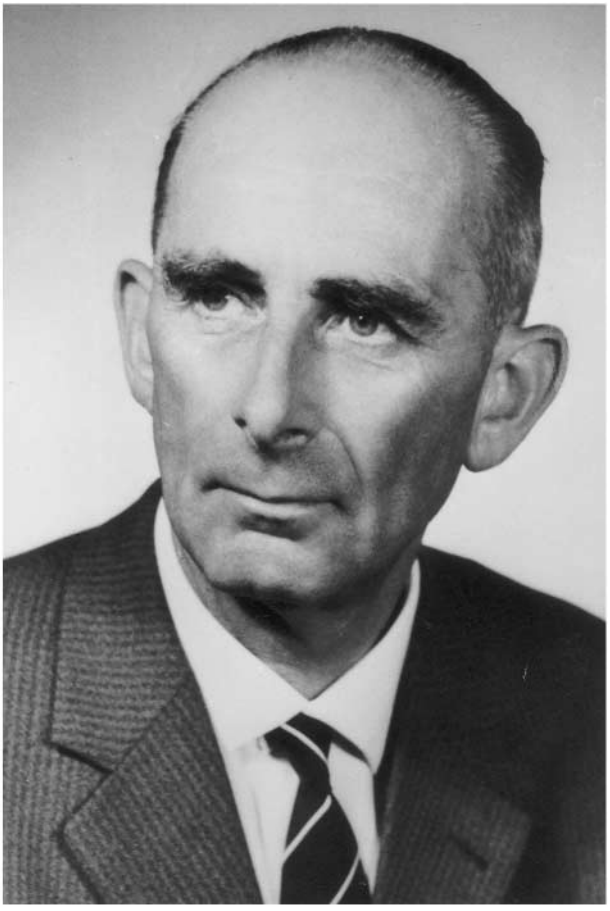

Fig. 1. Rolf Wideröe (1902–1996).

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the topic for his doctorate thesis himself. This was to construct a betatron based on his own ideas. Wideröe imagined that this could perhaps be his contribution to fulfilling Rutherford's wish to obtain more suitable 'projectiles' for further studies similar to those implemented by Rutherford when he discovered the atomic nucleus in 1911.

Having had his proposal rejected by his former university in Karlsruhe, the indefatigable Wideröe applied instead to *Die Rheinisch-Westfälische Technische Hochschule* in Achen. He was delighted when his proposal was accepted by Professor Rogowski, and in May 1926 Wideröe began work in earnest.

Despite working extremely hard on the project (as was his custom), he failed to transform his theories into a practical working betatron. Since Rogowski was result-oriented, he refused Wideröe his doctorate on the grounds that the apparatus did not work. Wideröe was forced into a corner.

He turned to the work of the Swedish physicist Gustaf Ising, who in 1924 had proposed a principle for multiple acceleration or sequential acceleration of charged particles in a rectilinear path.

Wideröe realized Ising's concept by launching the principle of *alternating current-based* multiple acceleration. On this principle, Wideröe constructed the world's first linear accelerator, and then proceeded to show that it worked by accelerating calcium and sodium ions in an ingenious drift-tube arrangement to 50 keV (in two successive stages of 25 keV each) in the high-frequency voltage field.

The principle of alternating current-based multiple acceleration formed the basis for the fantastic development of both linear and circular accelerators throughout the 20th century. Moreover, Wideröe's linear accelerator prototype was also the forerunner of the heavy ion linear accelerator. For example, when the decision was made to build the gigantic heavy ion accelerator in Darmstadt in Germany a quarter of a century later, its first stage was a linear accelerator similar to the one Wideröe had described in his doctoral thesis! It is interesting to note that Wideröe completed his thesis before the first (and in principle simpler) single-stage accelerators had been commissioned.

The young engineer could now submit his thesis entitled *Über ein neues Prinzip zur Herstellung hoher Spannungen* (2):

In the main section of his thesis he described the principles for the linear accelerator together with its construction and test results.

In Chapter IV he presented the first comprehensive description of the principles for the betatron, which he had not yet got to work in practice. However, Wideröe included in his thesis the fundamental 2:1-equation for the magnetic fields in the accelerating and deflecting regions that was necessary to stabilize the accelerated electrons in the horizontal plane—an equation which in betatron-literature gradually became known as 'the Wideröe relation'.

Wideröe became a Doctor of Engineering (D.Eng.) on 28 November 1927. Some years later, the Norwegian-born American physicist Ernest O. Lawrence chanced upon a copy of Wideröe's thesis in a library. Lawrence had no knowledge of German, but the sketches and mathematics in the publication were sufficient to give him the idea to build the worlds first cyclotron, for which he was awarded the Nobel Prize in Physics in 1939. Lawrence praised Wideröe on numerous occasions for having inspired him to this invention.

In essence, it may be said that Lawrence's cyclotron was in principle the same as Wideröe's linear accelerator, the main difference being that Lawrence introduced a fixed magnetic field so that the path of the particles became circular.

From 1928 to autumn 1943 Wideröe worked in industry, designing and constructing power stations, transformers, and high-voltage power lines. He worked in Germany for a short while before returning to Norway where he ended up working for Brown Boveri & Cie's subsidiary, NEBB.

Even though he had a full-time job in industry, Wideröe managed to make a name for himself as a researcher in the development of new accelerator technology. By the 1940s the development of accelerators was progressing rapidly. This led in 1941 to Dr. D. W. Kerst in the USA building the first *functional* betatron. Kerst referred to Wideröe's thesis in his publication of this successful invention (3).

This was a great fillip to Wideröe, and prompted him on 15 September 1942 to submit a document for publication in *Archiv für Electrotechnik*. In this article Wideröe not only discussed his previous work with the betatron and Kerst's subsequent follow-up, he also presented new and original ideas for the construction of future betatrons with higher energies and intensities. He focused on the design and construction of a 100 MeV betatron, and even included a breakdown of costs (4).

In June 1943, Wideröe sent another article to the same magazine, in which he presented certain speculative ideas for a 200 MeV betatron. For some reason, this was not published. We will return to this work later.

II. EVENTS DURING THE EARLY YEARS OF THE WAR WHICH HAD A SERIOUS IMPACT ON THE ENTIRE WIDERÖE FAMILY

Soon after the outbreak of World War II, Rolf Wideröe's younger brother by two years, Viggo, joined a resistance group in Norway involved in helping people wanted by the Germans, and others who sought to oppose the Nazi regimen, to escape to England. However, in May 1941 the group was arrested and tried by a court martial. Five of the group were sentenced to death. Viggo was sentenced to 10 years' hard labour, to be served in concentration camps in Germany, and the others received lighter sentences. Viggo was transported to Germany in January 1942, where he remained incarcerated until the end of the war.

News gradually came back from Germany through various channels that Viggo's health was deteriorating due to forced labour, malnutrition and illness. The entire Wideröe family was, of course, extremely concerned.

In an attempt to save his brother, Rolf Wideröe decided to apply to the German authorities for a pardon. In his work for NEBB in Oslo Wideröe had come into contact with a German manager called Schwartz, employed in *Reichkommisariats Arbeitsgemainschaft für den Ausbau der Norwegischen Wasserkräfte*. Schwartz promised to support Wideröe's application, which was to be processed by his superior, D. Eng. Todt, who in turn would pass his recommendation up the hierarchical ladder. As a concession, Wideröe had to demonstrate that he was sympathetic towards the German cause by, for example, writing articles in technical publications using pro-German language, and/or making financial contributions to pro-German organizations. Wideröe agreed to both these terms in the hope that this would give his application a greater chance of success.

In autumn 1943, a delegation of x-ray specialists arrived from Germany to discuss with Wideröe plans to cooperate on the development of betatron technology. Meetings were held over two days in the Grand Hotel, Oslo.

Apart from general information provided by Wideröe and his defence lawyers during, inter alia, the police court in 1945/6, little is known of exactly what was said at these meetings. The members of the delegation were, according to Wideröe, well-briefed about his expertise in accelerator technology; they knew his full background, from his thesis work in Achen in 1927 right up to the above-mentioned articles published in/submitted to *Archiv für Electrotechnik*.

The delegation treated Wideröe with respect and deference—as a person with an outstanding international reputation in accelerator technology. The talks revolved around the fact that Dr Kerst had managed to build the first operative betatron at the University of Illinois in 1941, which had generated radiation with an energy of 2.3 MeV and radiation doses equivalent to that, from one gram of radium. The Germans took this as an indication that accelerator-generated radiation could compete economically with radium for use in cancer radiation treatment.

The Germans claimed, therefore, that they had decided to develop a 15 MeV betatron for generating beams of electrons and *bremsstrahlung*, and to test their potential in treatment of deep-seated cancer tumours.

The Germans asked Wideröe (who they considered to be Europe's foremost expert on accelerator technology) to assist them in this development-work as technical scientific leader of the project. It was emphasized that the project would be given high priority and guaranteed adequate resources with regard to funding, staff and alliance partners for instrumentation and production. The delegation presented the project as civil-targeted, and mentioned nothing about military objectives.

In late autumn 1943, the Allies had started a major bombing campaign on German cities, and this ruled out any idea of Wideröe taking his family to live there. The Germans offered a solution: His family could remain in Oslo while Wideröe himself would be allowed considerable freedom to 'commute' between Oslo and Hamburg. It was proposed that he could carry out as much of his work as was practicably possible in Oslo, such as theoretical and design activities.

Wideröe regarded the German offer to lead the betatron project as an exciting challenge, and he believed that the conditions were sufficient for the project to succeed. In view of what he had recently published about how high-energy radiation could be generated using betatron technology, the proposal seemed even more attractive! Moreover, Wideröe had been theorizing for some time that accelerator-generated high-energy radiation would most probably provide a major leap forward in radiation therapy of deep-seated cancer tumours. Therefore, he felt that if he succeeded with this development work, he would have accomplished a great service to mankind.

In his evaluation of the political implications of the project, Wideröe was convinced that a 15 MeV betatron could not be of any military significance to the Germans, and this subsequently proved to be an accurate appraisal. The fortunes of war had changed dramatically in favour of the Allies. With the German defeat at Stalingrad and retreat on all fronts, it would have been unrealistic to expect the project to extend beyond the construction of an operative betatron, even with considerable progress in the development work, before Germany finally capitulated.

Nevertheless, there was always the possibility that he would turn down the offer because of the stifled reluctance that predominated Norwegian opinion at the time against any form of collaboration with the Germans. However, as mentioned earlier, Wideröe was willing to do almost anything to help his brother who currently sat in a German concentration camp. Now he felt that he unexpectedly might have acquired a 'trump card': Wideröe asked the German delegation members whether it would support his application for a pardon for his brother *if* he went along with their research programme. They replied that his brother's case came under the jurisdiction of the *Sicherheitsdienst* [the German security service (SD)], but that they would make every effort to persuade the SD to release him, or at least to provide him with better conditions.

This reply was decisive for Wideröe. He agreed to join the delegation in Germany to discuss the project in more detail. That same day they flew to Berlin in a German

aircraft. In Berlin, the negotiations for his participation in the project were completed, inter alia through an agreement with the firm NEBB in Norway that he would continue to be employed by that company while on secondment to the project in Hamburg. In return, he received confirmation from the Germans of their promise to help his brother.

III. WORK IN HAMBURG FROM OCTOBER 1943 TO APRIL 1945

Wideröe worked on the development of the betatron project in Hamburg from October 1943 to April 1945. Within a few months Wideröe had made several ingenious inventions, some of which had considerable influence on the future development of accelerator technology: For instance, while relaxing on the lawn of his hotel during a brief vacation in Tuddal in Telemark (Norway), Wideröe came up with the idea of studying nuclear interactions by using colliding particle beams in so-called *storage rings*. He patented this idea in Germany in 1943 as '*Anordnung zur Herbeiführung von Kernreaktionen*'.

It is interesting that this principle was used, inter alia, by the European nuclear research centre CERN, when the famous intersecting storage rings were built there under the leadership of the Norwegian Kjell Johnsen, almost a quarter of a century later.

Wideröe more often than not contented himself by simply 'publishing' his scientific and technological results as patent rights. Unfortunately, this did not ensure priority for the invention as publication in publicly accessible scientific literature would have done. Consequently, the honour for this invention went to Drs D. W. Kerst and G. K. O'Neill, despite the fact that their 'invention' appeared 13 years later.

About the same time, Wideröe took out a number of patents concerning how electrical and magnetic lenses could be used to stabilize particle paths in accelerators, and how particles could be injected into and extracted from such devices.

Parallel with this inventiveness activity, Wideröe worked in all haste on the main project, i.e. to develop a 15 MeV betatron. In summer 1944 Wideröe was able to implement the first successful test run. Initial studies showed that the *bremsstrahlung* produced had an energy of 12–14 MeV.

Germany's surrender was imminent. In April 1945, Wideröe was released from his imposed research duties and was paid a licence fee for the use of nearly 30 of his patent rights during the betatron project. According to Wideröe, he managed to acquire a considerable amount of documentation relating to his work in Germany. With this, he boarded a train back to Norway, oblivious of the scandal he was about to face.

IV. WIDERÖE'S RETURN TO NORWAY AND ITS JUDICIAL SYSTEM

IV.A The arrest of and the legal proceedings against Wideröe

In spring 1945, after 5 years of occupation, the Norwegian people were extremely intolerant of anything related to Germans and Germany. When Wideröe returned to Norway in April 1945, the country was still occupied, but shortly after the German surrender in Norway on 8 May, an anonymous report about Wideröe was sent to the Oslo Police Headquarters, stating, among other things, that:

> Engineer Rolf Wideröe … has made important inventions re. the V-bomb. It was he who invented the gyroscope for the V2.

Further documents reveal that based on this anonymous report the Norwegian authorities had decided to arrest Wideröe. A warrant for his arrest was issued on 23 May 1945 at the Oslo and Aker Police Headquarters. It stated one reason for his arrest and one reason only: 'Has made inventions re. V-bombs.'

The documents show that Wideröe was arrested in the middle of the night between 23 and 24 May 1945, that his passport was confiscated, and that he was incarcerated in the Ilebu gaol for traitors.

It must be emphasized here that Wideröe was facing a *very* serious charge indeed. The reader is asked to consider what penalty would have been meted out in any Allied country in 1945 to a person found guilty of contributing towards German V-2 rockets reaching London and Antwerp and causing death, serious injury and mass destruction.

The day after his arrest, Wideröe was called in to a 'conference' by the director of NEBB and summarily dismissed from his post. In Norway in the 1940s, it was clearly not the done thing to query whether or not dismissal from a job was *justified*. That is to say, Wideröe was dismissed *before* the prosecuting authorities had even *begun* its work of critically evaluating the legitimacy of the report, let alone prosecuting him!

The *official* charge against Wideröe was presented on 20 June 1945, and read as follows:

> 'Wideröe is charged with contravening Section 2 of the Treason Act of 15 December 1944, in that he: a) worked as an engineer in German factories in Germany, and thereby collaborated with the enemy, b) is suspected of having made an important invention with regard to V-bombs, and of placing this at the disposal of the enemy.'

Thus, in the month between the warrant being issued and up to the time he was charged, an element of doubt had begun to set in about the legitimacy of the anonymous report. The prosecuting authority's wording of Wideröe's work with the V-bomb had at any rate changed from being a *fact* to a *suspicion*!

Oslo magistrate's court decided that if no further documentation was forthcoming concerning the legitimacy of the charges, then Wideröe could not be held in gaol beyond 9 July 1945. Thus, after spending 47 days behind bars he was released on condition that he reported to the authorities every Monday and Friday.

It soon became clear to the prosecuting authorities that they needed help from scientific experts to clarify exactly what kind of work Wideröe had undertaken in Germany, and to evaluate any possible military significance of this work.

However, the Allies had for a long time already implemented an extensive investigation of the whole of the German military research establishment. Norway had taken part in this investigation and had been represented by Captain (at that time) Gunnar Randers. With reference to the fact that through this work Norway had 'acquired a full overview of Wideröe's work in Germany', the chief prosecutor (case worker) on 24 September 1945 sent the Director of Public Prosecutions (DPP) a reasoned proposal for four persons who should be included in the Expert Committee, a proposal which the DPP executed without making any changes.

Based on the wording of the charge and information in the Oslo magistrate's court records of 21 November 1945, it follows that the prosecuting authority gave the Committee the task of:

> *clarifying the type and evaluating the significance (military importance) of the work Wideröe had done as regards the two items specified in the official charge*. (See above)

IV.B Important coincidences

It is almost inconceivable that under such stressful circumstances Wideröe even managed to dedicate time and effort to scientific invention. During this difficult period, including the time he spent in Ilebu prison, Wideröe accomplished yet another breakthrough by developing and patenting principles for a new type of accelerator, the synchrotron. Subsequently it was possible to generate corpuscular radiation with higher energy and within a more acceptable economic framework than hitherto possible.

It is interesting that E. M. McMillan in the USA and V. Veksler in the USSR came up with similar inventions at about the same time and independent of one another, all perhaps influenced by the work of Sir Mark Oliphant.

The synchrotron principle was an important discovery, not only for future accelerator construction, but also for further development of the physics of elementary particles. Moreover, the synchrotron principle was currently a Norwegian patent when CERN built its first proton synchrotron, with Wideröe as a consultant.

In 1945, BB&C, the parent company in Switzerland, dispatched an official request to Wideröe to discuss an offer of professional cooperation concerning the planning and industrial production of betatrons for use in the radiation therapy of cancer patients. Based on the unique expertise that Wideröe had acquired via his successful work in Hamburg during the war, the company realized that he would be the ideal person to conduct this work.

Moreover, market analyses carried out by the company showed that it was important for neutral Switzerland to implement such a project as quickly as possible, before the rest of war-torn Europe had chance to revive its non-military industrial production. Wideröe was therefore under strong pressure from the company to join this development work as *soon* as possible.

While the Swiss offered Wideröe an attractive research position because of his expertise from the work in Germany during the war, the Norwegians put him in prison as a traitor! Wideröe was therefore not allowed to leave Norway because of his pending trial.

IV.C Conclusions from the Expert Committee's report

IV.C1. The Committee's contribution towards clarifying the type and military significance of Wideröe's work in Germany

The Expert Committee sent its report to the prosecuting authorities on 14 February 1946. Despite the fact that the main conclusions in the report are found in various places, and sometimes squeezed into lengthy and complex wording, they may be summarized in the following three points:

1. Wideröe had had *nothing* to do with the V2 rockets.
2. During his stay in Germany Wideröe had spent *all* his time developing a 15 MeV betatron, and
3. This work had *not* been of any military value to the Germans. In addition, the Committee concluded that:
4. 'The technical and scientific value of his work should *not have any influence* on the outcome of his case, which should be *based on pure legal viewpoints*.'
5. Based on the conclusion in point 4 'the Committee believes that *further* scientific discussions in this context *are unnecessary*.'

Even though these conclusions were inevitable, all credit must be given to the Committee for this part of its work, considering the spirit and attitude that prevailed in Norway in 1945/6.

IV.C2. The Committee's contribution to blacken Wideröe's reputation as a scientist and person

In its report to the prosecuting authorities, the Committee found it necessary to limit its mandate by wishing:

> …naturally enough to have as *little influence as possible* on deciding the *verdict*, which it believes should be based on agreed universally legal viewpoints, which *only* the court can decide.

Similarly, the Committee ascertained that:

'…the question of whether he (Wideröe) has provided the enemy with a service is a legal juridical issue.'

In analogy with the foregoing statement of the Committee, this implies that also the latter type of decision falls outside that on which the Committee wished to have influence.

Against this background it is disappointing to note that the Expert Committee, beyond both the mandate given, with self-imposed restrictions, and its professional competence in physics, 'lectures' the prosecuting authorities about Wideröe's abilities, system and future opportunities, by stating that his work *so far* had included *nothing original* worth mentioning, and that there was *no reason* to believe that his *future work* on the betatron project would succeed, because the Committee could ascertain that as *a physicist* he was an *outsider*, with minimal understanding of *theoretical physics* and with *limited capacity* as a *leader*.

These allegations made by the Expert Committee, beyond its terms of reference, came to be weighty contributions for the future blackening of Wideröe's reputation as a scientist and person.

IV.C3. The Committee's failure to report on issues that would have explained/supported Wideröe's case

As mentioned earlier, Wideröe's brother had been incarcerated in German concentration camps from January 1942 until the end of the war, and Wideröe had tried to help him by requesting the German authorities to grant him a pardon. Wideröe further claimed that the decisive factor for him being persuaded to join the betatron project in Hamburg was promises of help from the German delegation to try and get the authorities to improve his brother's situation, or possible even get him released. Even though his brother was never granted a pardon, Viggo wrote in a letter to the prosecuting authorities on 8 July 1946 that the help he got from Rolf (and a named member of the German delegation with which Wideröe had negotiated in 1943) had been crucial for him surviving the concentration camps! The Committee did not find this worth mentioning in its report.

The Committee allocated a considerable amount of space in its report to scoff at the fact that Wideröe had failed to come up with an *operative* betatron during his doctorate studies in 1927. They went to unreasonable lengths, for example, to trivialize Wideröe's contribution towards the development of this accelerator type, to the benefit of D. W. Kerst.

It is remarkable that the Committee regarded his doctoral thesis as so important in view of the fact that its task was to clarify the type and military significance of Wideröe's work during a short period some 16 years later.

Since the Committee nevertheless found it necessary to dwell on something that Wideröe had *not* managed successfully to complete in his doctoral thesis, one might be tempted to ask why at the same time it did not find it justified to comment on something that on record he *had* succeeded with in the same work? Why was nothing said about his *success* in constructing the world's first linear accelerator, by which he proved that the principle of alternating current-induced multiple acceleration of charged particles worked also in practice in his original drift-tube design? Why didn't the Committee mention anything about Wideröe's patenting of the principle for initiating nuclear interactions by using colliding particle beams in so-called storage rings? Why was nothing said about Wideröe having patented the fundamental principles for the synchrotron, work which in part was done during his incarceration in Ilebu prison? The Committee must have been impressed by this achievement, coming as it did immediately prior to its submission of its recommendations to the prosecuting authorities!

Instead, the Committee chose to belittle the fact that Wideröe had taken out patents and that he had offered to cooperate with the Norwegian authorities and allowed them access to the material and knowledge that he had brought back with him from Germany!

IV.D The Committee's influence on the processing of repeated requests from Wideröe to have his passport returned

As mentioned above, while sitting in Ilebu prison, Wideröe was offered a position in the parent company (BB&C) in Switzerland to take part in the technical leadership of the development and industrial production of betatrons, primarily for use in cancer radiotherapy.

At the Norwegian Radium Hospital, director Dr Rolf Bull-Engelstad was at the same time working on plans to procure new equipment for the hospital, to be on the cutting-edge of the technological revolution of radiation therapy that he foresaw as a result of the availability of high-energy accelerator-generated radiation. Both he and director Torstensen at NEBB, wrote to the prosecuting authorities and recommended that Wideröe should be given the opportunity to take part in the development work in Switzerland.

Thereafter, the dynamic Wideröe 'bombarded' the prosecuting authorities with requests to have his passport returned so that he could attend the preliminary meetings in Switzerland. The case worker presented these applications to the Expert Committee, which consistently opposed the return of his passport.

One such reply characterized the Committee's attitude to both the case and the person. Committee chairman Professor Hylleraas said (in a reply to advocate Gustav B. Dreyer):

'As the Committee's report will show, engineer Wideröe's planned trip to Baden (Switzerland) would *not* be regarded as having *any* significance for society (the public), *but* would *only* serve his *own personal*

> interests. The trip is a political issue for which the Committee will *not* be responsible. The Committee will merely state that such a journey would give Wideröe every opportunity to explain *his* side of the case to his foreign connections—also with regard to hypothetical Norwegian interests. *The invitation* from Brown Boveri must *no doubt* be regarded as the result of an *initiative* taken by Wideröe himself.'

However, after the Committee had submitted its report, which stated, among other things, that the serious allegation against Wideröe concerning his contribution to the development of the V2 rockets was a fabrication, the case worker decided *on his own initiative* to grant Wideröe a restricted passport.

Based on the public opinion that prevailed in 1945/6, the issuing of a passport to Wideröe prompted a rancorous critique in *Dagbladet* (11 and 17 September 1946) against those considered responsible for this act.

The Committee (via its chairman) found it seasonable to become involved in this public debate, and on 11 September 1946 printed a statement which effectively 'absolved' the Committee from having *recommended* issuing the passport.

Another committee member also gave an interview to the newspaper (17/9/46) in which, inter alia, he said:

> 'We have *not* recommended any journey. Nor was there any *scientific* reason to *support* his trip to Switzerland. We advised that he should be *treated* as someone *guilty of treason* and all that entails. We have said nothing to the contrary.'

Neither a member of a committee of experts nor any other official involved in a trial should make public statements that could prejudice the accused. In this case the member concerned spoke to the press immediately before the case against Wideröe was about to be decided. Nor was the situation helped by the climate of public opinion that prevailed in 1945/6, since there was little willingness on anyone's part to promote the views of the *accused*.

IV.E The legal proceedings against Wideröe are concluded

IV.E1. Introduction

Clarification that Wideröe had no connection with the V-bombs was, of course, of dramatic significance. It showed that the entire case against Wideröe had 'gone off' at a completely unacceptable tangent by allowing his arrest on the basis of an *anonymous* informer—who was later to be proved *unreliable*!

This alone throws a grave shadow over the legal proceedings against Wideröe. If this had not happened, there is reason to believe that the case would have taken another, more balanced course.

Moreover, since it soon became apparent that Wideröe had spent *all* his time in Germany developing a 15 MeV betatron, and that this work was of *no* military significance to the Germans, the patently obvious conclusion is that the whole case was a genuine *over-reaction* on the part of the prosecuting authorities.

One cannot discount the possibility that it now became important to 'find' other issues to charge Wideröe with, to 'justify', among other things, his being held on remand for 47 days.

Sadly, it may even be considered that some of the Committee's recommendations—beyond its mandate—became quite 'useful' for the prosecuting authorities in this context.

IV.E2 The case worker reports to the DPP.

When it became clear to the case worker that the main charge had crumbled away, he decided that the remaining part of the charge was now so insignificant that the case should be concluded with a mere penalty notice.

Concerning this, the case worker says that he would prefer not to impose either a fine or loss of civil liberties, but that a fine of NOK 5000 would nevertheless have to be upheld *because* Wideröe had been held on remand for 47 days. The legal ground for *additionally* fining Wideröe '*on account of* the period held on remand', which was the result of the anonymous and false information, is rather doubtful.

The case worker further recommends that Wideröe should only forfeit NOK 120000 of the amount he was paid in licence fees for use of his patent rights during the betatron development, instead of NOK 140000.

This document from the case worker was important in that it implied that the prosecuting authorities were now treating the case tactically, after the serious part of the charge had been dropped.

Among the case worker's reasons for his recommendation, the following is worth repeating:

> 'My possibly somewhat lenient report on Wideröe is primarily attributed to the fact that I believe he will be one of the more valuable people to keep. Too harsh a punishment now could result in his emigration, or at least his working abroad, which would not help our national economy.'

However, it would appear that the case worker's recommendation for not depriving Wideröe of his civil liberties was not heard by higher authorities, although, as will soon become evident, the amount the authorities wanted to confiscate was reduced, in accordance with the proposal of the case worker.

IV.E3. The case is decided with a penalty notice

For Wideröe and his family, the time in Norway subsequent to his return from Germany in April 1945 was one of continuous humiliation. His wife and children were teased and mobbed. They dreaded opening the newspapers: 'What are they writing about us today?'.

Every time a new report appeared in the press (e.g. ref. *Dagbladet* of 6, 11 & 17 September 1946) the fingers would point and tongues would wag. The trial must have been traumatic period also for the rest of the Wideröe family, too.

Wideröe himself had the ability to ignore gossip and public scorn, but his wife and children were more vulnerable. After a while they had one wish and one wish only: *To see an end to the legal proceedings as quickly as humanly possible*, in order to start a new life!

Since BB&C in Switzerland were pressuring Wideröe to accept the job in the company as soon as possible, Wideröe capitulated and informed the prosecuting authorities that he would agree to the matter being concluded with a penalty notice, and thus, on 2 November 1946, he agreed to sign it.

The prosecuting authorities in 1945/6 were not prepared to accept as *mitigating circumstances* the fact that Wideröe, by his actions both prior to and after his development work with the betatron in Hamburg in 1943/5, had been attempting to save his brother from the German concentration camps, even though the brother had written a letter to the prosecuting authorities on 8 July stating that the help he got from Rolf had been crucial for him *surviving* the time he spent in these camps! On the contrary, there remained in the final penalty notice the explicit accusations of a NOK 80 contribution to *Den Norske Legion* and an article in *Norsk Teknisk Ukeblad*.

Wideröe had hoped that his professional work in Germany during the war would not be interpreted as a lack of national loyalty, but rather accepted as a desire to improve the technological foundation of radiotherapy, as a project to the benefit of mankind, for which he himself thought he had excellent qualifications and strong motivation. But his pleas fell on deaf ears. The authorities seized NOK 120000 in licence fees received by Wideröe for the use of almost 30 of his authorized patents during the betatron development, instead of submitting the amount to the tax authorities for the retrospective tax assessment, as was the main way in 1945/6 to administer financial gains during the war time.

Wideröe had to sell almost everything he owned and use his savings to settle the financial obligations imposed by the court. Subsequently, he was issued a *special passport*, valid for Zürich! (He was not granted a normal passport until April 1947, after which he was able to participate in international scientific conferences as and when he wanted.)

V. SUMMARY OF MILESTONES IN WIDERÖE'S LIFE AFTER AUTUMN 1946

V.A Wideröe moves to Switzerland

In autumn 1946, Wideröe took up a position as head of development with BB&C in Switzerland. He retained his Norwegian citizenship and lived with his family under rather primitive conditions in Zürich. The trial in Norway had left him in such dire straits that he had to sell BB&C his patent rights for the synchrotron.

Wideröe once again immersed himself in his work. It was decided to prioritize the development of a 31 MeV betatron. The first was ordered by Kantonsspital in Zürich. This was installed in autumn 1949, the first betatron for medical purposes to be constructed in Europe.

With Wideröe's assistance, the director of the Norwegian Radium Hospital, Reidar Eker, managed to gain an option on the second betatron. This was delivered in 1952. With this procurement, the hospital was at the forefront of an interesting and dramatic reorganization of radiation therapy brought about by accelerator-generated high-energy radiation, which gradually spread across the whole world.

In the period up to 1968, under Wideröe's leadership, BB&C produced 78 betatrons for export around the world. Most of them were installed in hospitals, but some were bought by technical/scientific research institutions for use in fundamental nuclear physics research programmes and various forms of material testing.

In addition to his contribution to the development of accelerator technology, Wideröe also influenced radiation therapy in another way. From 1960 onwards he spent an increasing amount of time studying how ionizing radiation affects cells and body tissue. In the last 35 years of his life Wideröe became increasingly involved in *theoretical radiobiological research*, and he even managed to leave his mark in this field of study: Under certain conditions, the relationship between absorbed radiation dose and cell survival can be shown by a mathematical formula which among other things takes account of the ionization density of the radiation. Together with others, Wideröe has contributed towards the 'two-component theory' or the 'α/β model', which has been used both in radiobiological research and in practical dose planning in the radiation treatment of cancer.

In this way, Wideröe has contributed to the improvement of radiation therapy through the development of new accelerator technology as well as new radiobiological concepts.

V.B Disparity between Wideröe's national and international reputation as a scientist and researcher

It is worth taking a retrospective look at the Expert Committee's characterization of Wideröe, in light of what *really* happened:

In 1962, Wideröe was made an honorary doctor by the *Rheinisch-Westfälische Technische Hochschule* in Achen (Dr.ing. e. h. '*ehrenhalber*' [D.Eng.]); in 1963 titular professor by the *Eidgenössische Technische Hochschule* in Zürich, and in 1964 honorary medical doctor by the University of Zürich (Dr. med. h. c. [M. D. of honoris causa]).

In 1969 he was awarded Remscheid's '*Röntgenmedaille*'; in 1971 he won *'Der Röntgenpreis*' from the city of Würzburg and its '*Physikalisch Medizinische Gesellschaft*', in 1973 he was awarded the 'Gold Medal' during the XIIIth International Congress of Radiology, Madrid; and in 1992 the American Physical Society awarded him the 'Robert Wilson Prize for Achievement in the Physics of Particle Accelerators'. In the same year, 65 years after Wideröe took his doctorate, he was introduced by Dr G. A. Voss during the Hamburg Accelerator Conference as '*Urvater*' and 'originator' of the science of particle accelerators.

Wideröe had been engaged as a consultant in the planning of a number of major accelerator centres, such as CERN in Geneva, DESY in Hamburg, GSI in Darmstadt and SIN in Villigen.

In 1985, Wideröe was proposed as a candidate for the Nobel Prize in physics. There might have been various reasons for him not winning the prize, but none of the three surviving members of the Expert Committee had signed the proposal.

VI. NEW HYPOTHESIS ON WHY AND HOW WIDERÖE CAME TO WORK IN GERMANY FROM OCTOBER 1943 TO APRIL 1945

VI.A Reasons presented by the Expert Committee

In Section IV.A, an account is given of how Captain Gunnar Randers had represented Norway in Allied Security in its investigation of German military research during the war. This work led the prosecuting authorities to the conclusion that 'the Allies (had) acquired a full overview (also) of Wideröe's work in Germany'. Because of this insight Randers inevitably also became a member of the Expert Committee.

Despite this thorough knowledge of Wideröe's work in Germany during the war, the Expert Committee's *explanation* of the reason the Germans wanted to engage Wideröe in the betatron project in Hamburg is quite vague. In their report, the Committee presented two reasons, and two reasons only: a) high-energy radiation produced by betatron technology, could perhaps be used to render enemy aircraft harmless, according to a concept proposed by a certain Dr Schiebold, and b) the Germans might have 'wanted to compete with the Americans in a new area that could perhaps have been important for nuclear physics and possibly indirectly for nuclear weapons'.

VI.B An unexplained phenomenon

There can be no doubt that the Expert Committee *knew* that project a) was utter technological absurdity. Thus, there remained only the loftily worded competitive aspect b). However, as presented in Section IV.C1, the committee itself concluded that Wideröe during his stay in Germany had spent all his time on developing a 15 MeV betatron, and that this work had not been of any military value to the Germans. If the German motivation really was to engage Wideröe in effectuating a project without any military value, then this in itself is difficult to understand, in line with other related questions, such as:

- Why was Wideröe given the leadership of the project, with the authority to run it apparently as he seemed fit?
- Why was he brought to Germany almost by lightning action, and apparently without use of force?
- Why was he so generously provided with financial, personnel, and industrial resources?
- Why was he allowed so much freedom during his stay in Germany, and given ample opportunity to commute between Hamburg and Oslo?
- Finally, why did the collaboration begin in October 1943?

The author has come to the conclusion that neither the Expert Committee nor the Allied Security had ever found the *real* reasons why Wideröe came to join the betatron project in Hamburg late in the autumn 1943.

VI.C Wideröe's recognition as an eminent accelerator designer/constructor

The following events, listed in chronological order, may have opened the eyes of the German authorities in the autumn of 1943 to Wideröe being an exceptionally brilliant and productive accelerator specialist:

1. Wideröe had won a great deal of respect among the teaching faculty at *Die Technische Universität* in Karlsruhe as early as 1920–1924. His reputation was further enhanced when he arrived at *Die Rheinisch-Westfälische Technische Hochschule* in Achen to take a doctorate in the new field of accelerator technology, and even on a subject he himself had chosen. The respect in academic circles for his scientific ability and creativity reached new heights in the way he completed his doctoral thesis.
2. Even before the war and during the initial war years when he worked in industry, he succeeded in reinforcing his international standing even further as an inventive accelerator designer. In September 1942 he had submitted a document for publication entitled *'Der Strahlentransformator*', with proposals for development of betatrons with much higher energies and intensities than hitherto available. In addition, he drew up detailed construction plans including a cost analysis, for a 100 MeV machine.
3. In 1942 he established contact with BB&C in Switzerland concerning industrial cooperation for utilizing his various inventions in betatron technology. As part of this cooperation the firm 'requested and reminded Wideröe to get his inventions patented in Germany, and possibly also in the *USA* and *England*'. In the

spring and summer of 1943, Wideröe negotiated with BB&C for the *sale* of some of his patents and for taking out patents in *English-speaking countries*.
4. In June 1943, Wideröe had sent another manuscript for publication in '*Archiv für Electrotechnik*' with some more speculative ideas for a 200 MeV machine. For some unknown reason this work was never published. (cf. Section I).
5. At about the same time Wideröe applied for patents on the injection of electrons in and extraction from betatrons.
6. Late in the year 1943 Wideröe came up with the idea of studying nuclear reactions by using colliding particle beams in so-called storage rings, patented in Germany as '*Anordnung zur Herbeiführung von Kernreaktionen*'.

Surveillance in Germany during the war was so thorough and exhaustive that it is only natural to assume that through the points presented above the *Sicherheitsdienst* [the German security service (SD)] had reinforced their opinion that the Norwegian Wideröe was an outstanding and motivated particle accelerator specialist, and very likely Europe's foremost expert on betatron technology.

VI.D German anxiety in 1943 for their own moderate progress in accelerator technology, and for possible undesirable consequences of Wideröe's contact with BB&C in neutral Switzerland

1. The Germans knew that over a long time the Allies and, in particular, the Americans had invested heavily and made considerable progress in accelerator technology. (cf. the works of, among others, D. W. Kerst and E. O. Lawrence). Even though the Germans themselves had *not* been able to assess whether this technology could be used for military purposes (apart from Schiebold's plans described and dismissed above), they were concerned that the Allies could be ahead in their research, and that perhaps they had 'better' plans. Thus, the Germans concluded that they had to develop fundamental know-how in this field in order to be positioned to apply it if/when the need arose.
2. Among the available accelerator technologies, that of the betatron appeared particularly promising for the Germans.
3. The Germans considered Wideröe to be Europe's foremost expert on this particular technology (cf. Section VI.C).
4. Wideröe's collaboration with the company BB&C in the neutral Switzerland (cf. Section VI.C, item 3) was assumed to represent a growing security risk, as his frequent technological innovations and stream of patents were likely rapidly to end up in the hands of the enemy, particularly when/if patented in English-speaking countries. This might give the Allies additional competitive advantages.

These aspects were so frightening for the Germans that the decision was unavoidable; Wideröe's connections with Switzerland had to be broken. It is not unlikely that the article which Wideröe had sent to *Archiv für Electrotechnik* in the autumn of 1943 (cf. Section VI.C, item 4) might have been decisive in prompting the Germans to complete and implement such a plan in the autumn of 1943.

VI.E German plan for converting this break into an exclusive advantage for themselves

It was equally important for the Germans to gain Wideröe's help in building up their own know-how in accelerator technology, for yet unidentifiable military purposes, as it was for them to break his contacts with Switzerland. Owing to the anti-German attitude that prevailed in Norway at that time, they realized that it would be hopeless to persuade him to become an active participant in such a project.

Sections I and II described how Wideröe's brother had been incarcerated in different concentration camps in Germany because of his resistance activities in Norway and that his case thereafter came under the jurisdiction of the German security police.

When reviewing the case, the Germans were reminded that Wideröe was very attached to his younger brother, and that he had been willing to go far to meet German requirements in his efforts to have his brother pardoned or granted better conditions in prison.

The Germans realized that Wideröe would probably have followed their orders had they threatened him with reprisals against his imprisoned brother if he did not break his contacts with BB&C in Switzerland and quit all plans for future publishing of his technological inventions. However, this would at the same time have jeopardized any plan to gain his help in strengthening their own research activities in accelerator technology. It therefore seems likely that they decided instead to try to work out a plan for securing Wideröe for themselves, and under conditions where as much as possible of his well-reputed hard-working habit and enthusiastic, creative technological nature was maintained intact. Thus, the strategy was to make the plan attractive and promising for Wideröe from a scientific and technological point of view and without any strings attached which might unnecessarily offend his national sentiment, so that he would voluntarily accept the offer.

In order to succeed in this task it is only natural to assume that the delegates who were sent to Oslo to meet Wideröe were instructed to do their utmost to generate a friendly atmosphere during the negotiations, and to treat him with respect and deference, honouring him for his many contributions over the years to accelerator technology.

The Germans realized that Wideröe would not consider taking part in a project with a military purpose. Therefore,

they devised a plan that involved inviting him to take part in the development of betatron technology, while presenting the project as civil-targeted.

It is against this background that the job-offer presented in Section II must be seen, i.e. to head the technological and scientific sector of a project within his own specialist field—betatron technology—with the purpose of developing a 15 MeV betatron and later possibly a 30 MeV machine, to meet demands from medicine and industry for, respectively the treatment of deep-seated cancer lesions and for non-destructive material testing.

As part of the offer he would be informed that the authorities considered the project so important that its progress should not be hindered by shortage of funding, staff, or industrial resources.

Little wonder that the plan was attractive for Wideröe from a scientific point of view. But, as he himself stated, the decisive factor for accepting it was the offer from the negotiating Committee to make every effort to persuade the *Sicherheitsdienst* to release his imprisoned brother, or at least to provide him with better conditions.

VI.F Views on Wideröe's research activities in Germany presented during the legal proceedings in 1945/6

As described in Section II, within a couple of days of the German negotiating team suddenly arriving in Norway, the home-loving Wideröe had been flown to Germany with 'a more or less voluntary agreement'. This remarkable German success suggests that their mission had been carefully planned, authorized by the political leadership, and professionally executed.

During the legal proceedings against Wideröe in 1945/6 it was insinuated without presentation of any evidence that the German delegation had perhaps also talked about the possible military applications of the project. It was insinuated that perhaps he had agreed to participate in such projects. These insinuations were strongly denied by Wideröe.

If the present hypothesis is correct it lends support to Wideröe's view. It would have been *totally illogical* of the delegation to have *ruined their plans* by introducing hypothetical *military* aspects, such as those proposed by Dr Schiebold. With his scientific and mathematical acumen, Wideröe would have immediately exposed Schiebold's theory as utter nonsense, with the consequence that his confidence in the project and trust in the negotiators would have dwindled. Moreover, military aspects would have quite unnecessarily reinforced Wideröe's national sentiments, which was exactly what the Germans wanted to avoid.

The prosecuting authorities and the Expert Committee were fundamentally opposed to Wideröe's participation in the betatron project in Hamburg, which they considered as proof of failing national loyalty. It appears as if the only excuse they could have accepted for his participation was proof that he had been subjected to threats and violence.

However, Wideröe was so important to the German security service that *it* would never have risked Wideröe falling into the hands of the Allies. Furthermore, they knew all along that they would succeed in keeping Wideröe under 'control', busily engaged in the betatron project, because they were holding the *'trump card'*, a veiled threat that would ensure success without having to turn to *physical violence*:

If Wideröe had refused to participate in the project, or after having joined the project had ever thought about taking his technological innovations to Switzerland, let alone collaborate with the Allies, or if he had ever failed to return to Germany after visiting his wife and family in Oslo, then it is almost certain that the SD would have quickly persuaded him to reconsider—by threatening to '*tighten the thumbscrews' on his brother*.

Therefore the security police *had never* even *considered* releasing Viggo from prison. By holding Viggo 'hostage' they were simultaneously guaranteed *full control over his much more important brother*.

It is in this perspective one has to read Wideröe's own formulation for his participation in the research work in Germany during the war, and here to appreciate his linguistic nuances:

> 'So I agreed to go to Hamburg or, to be more precise, I was 'subjected to compulsory work' with my more or less voluntary agreement (and that of my employers, NEBB).'

Thus, the deliberate, yet infamous and cleverly concealed result of the German strategy was that the Wideröe-brothers' destinies became bound in a close, relationship as mutual hostages in Germany—as pawns in a serious political game.

VII CONCLUSION

In retrospect, it is obvious that the Expert Committee lacked basic understanding of radiological physics, and because of this ignorance had failed to recognize that Wideröe's technological innovations would come to revolutionize the radiation therapy. Nor did it recognize that Wideröe, through his early pioneering work, was the founder of the science of accelerator technology, which came to have an enormous impact on the Committee's own specialist field—physics. The Committee's failure to recognize the great impact of Wideröe's work in that field is much more difficult to accept.

A serious complaint must be raised against the *basis* for the legal proceedings against Wideröe. From the time these were initiated in May 1945 up to the report of the Expert Committee in mid-February 1946, they were based on the extremely serious allegation that he had developed control systems for the terrifying V-bombs. In addition to the allegation originating from an *anonymous* source, and be-

ing the *only reason stated* for his arrest, it also proved to be *false*, without any basis in reality whatsoever! If the legal proceedings against Wideröe had been implemented in accordance with principles worthy of our Constitution, the anonymous information would not have been accepted at all. The process would then have followed a balanced and honourable course. *That* case, however, never came up for hearing. Consequently, *its* outcome remains unknown!

While the rest of the world has bestowed Wideröe with prizes, awards and honorary doctorates, Rolf Wideröe, the founder of the science of particle accelerators, the man who has contributed enormously to revolutionizing radiation therapy, stands as a *footnote* in the history of Norwegian physics, and with a *penalty notice* in the Norwegian legal records.

The time is long overdue for Wideröe to be redressed and in particular for his native country to acknowledge him as an outstanding scientist and inventor.

Wideröe's impressive ability to meet life's many challenges is aptly described in Johan Sebastian Welhaven's poem 'Byens Kirkegaard':

Kan du gjennom din Strid og din Daad,
bevare det barnlige Skjær til det Sidste;
da har du Regnbuen over din Graad,
da har du Glorien over din Kiste.

Some of its tender feelings may be perceived in the following translation:

If through your struggle and deed,
you preserve a child-like gleam to the end;
then, o'er your tears a rainbow beams,
then, o'er your coffin the glory prevails.

ACKNOWLEDGEMENTS

The original source material presented in this article concerning the legal proceedings against Wideröe became available when the author was granted permission by the National Archives of Norway and by the Wideröe family to view classified documents relating to Wideröe's trial in 1945/46.

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NOTE FROM THE EDITOR

The original manuscript included a number of informative footnotes, which had to be deleted in the present print. A complete, unabridged print is, however, available on request to the author.