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Oscar Buneman (1913-1993), Persecutions and Patronages: a Case Study of Political Impact on Research

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Abstract

We study scientific migration and patronage before and during the Second World War in the case of the student Oscar Buneman (1913-93), an eminent scientist later on. Our main source is the archive of the SPSL[1]. For those interested in Buneman[2] these records are important because of informations not available elsewhere, for other historians because Buneman belonged to a minority, not well known and not investigated much: non-Jewish and non-communist, anti-Nazi active before and after emigration like Willy Brandt (1913-92) and others, but mainly interested in mathematics and its applications, not politics.

KEYWORDS: Scientific migration, scientific patronage, alien internment, Society for the Protection of Science and Learning, Oscar Buneman, computer simulation.
MSC CLASSIFICATION CODES: 01A60, 01A74, 01A99, 65-03, 65Z05,

1 Introduction

We study scientific migration and scientific patronage before and during the Second World War in the case of Oscar Buneman (né Oscar Bünemann, 1913-93), pioneer of the numerical simulation of plasmas and of the visualisation of computed results, still and animated, and founder of the field of computer simulation using particles. Our

[1]SPSL - Society for the Protection of Science and Learning
[2]OB - Oscar Buneman alias Oscar Bünemann, Oskar Bünemann or Oscar Bunemann

main source is the file of the *Society for the Protection of Science and Learning (SPSL)* about him. It is found in their archive under "Files of correspondence relating to individual refugees [...] not funded by [...] the Society" and "academically eminent" [SPSL]. For those interested in Buneman himself these records are interesting because they contain informations not available anywhere else and not previously known to his family. For other historians these results should be interesting because Buneman belonged to a minority among emigrants which is not well known at all and which has not been investigated much: he was non-Jewish and not a communist, politically active against the Nazis both before and after his emigration, like the later chancellor Willy Brandt (né Herbert Ernst Karl Frahm, 1913-92) and others, but his main field of interest was mathematics and its applications, not politics.

Naturally, most of the literature is concerned with the emigration of people like Richard Courant, Richard von Mises, Albert Einstein, Max Born, Michael Polanyi and others who were famous scientists at the time of their emigration and who had a profound influence upon science in their old and new home countries [Rei76, Nye11]. Others became visible as emigrants because they told and published about their emigration experiences [Gold78, Per85, Kel10] or needed help [Nos12], or because they spoke all other languages with a thick German accent. Buneman did not tell much about emigration experiences, applied mathematics in the spirit of his education at University of Manchester [MSp12], and he had such a perfect British accent that his Stanford students assumed that he was British by birth [MSp14].

The topic of forced migration of scientists continues to attract the interest of historians of science. Archival research is still providing new insights into the plight of scholars on the run from Nazism and Fascism in the 20th century, because the explorations of many archives, including the one of SPSL [SPSL], are not yet completed. We propose to illuminate the challenges faced by German students and scientists during that calamitous time, as well as the support and patronage offered by fellow scientists, private citizens, and aid organizations in Britain and elsewhere, by the case history of Oscar Buneman. He is not mentioned in any of the lists of emigrants given in [RSS09, Rid84, Str87, SR80].

In Section 2 we briefly portray the eminent scientist Oscar Buneman, review the persecutions and patronages which strongly influenced his youth, show how these had consequences for all of his later life, and mention his scientific achievements. Since he happened to live at the time when computational physics and plasma physics arose as new fields of science and since he was at good places for this, he became a pioneer in these fields. Note that his mathematical education was a necessary prerequisite. For the convenience of readers who are not familiar with Buneman's topics of research we will give a short introduction to them.
In Section 3 we describe his life before his emigration, focussing on those events that were important for his later years. In Section 4 we describe his first years in Manchester, relying mostly on the informations we obtained from his SPSL-file [spsl-ob], enriched by informations from other sources. In Section 5.1 we repeat a few facts about internment and SPSL in general, for the convenience of some of our readers. Then we focus on the time of Buneman's internment, relying mostly on his SPSL-file [spsl-ob]. We conclude by reflecting about Buneman's case.

2 Biographical Overview

2.1 Life and Work

Oskar Bünemann was born in Milano in 1913 with German citizenship. He obtained British citizenship in 1944 and changed his name to *Oscar Buneman* around 1950. In his youth, political events made him move from Italy to Germany (1915, World War I), to Manchester (1935, after imprisonment by the Nazis in 1934-35), to the Isle of Man, Canada, Liverpool and again the Isle of Man (interned 1940-41), to Manchester (1941-44, magnetrons) and to Berkeley, USA (1944-45, Manhattan Project). After that he joined the Canadian & British Atomic Energy Projects in Montreal (fall 1945 to spring 1946) and at AERE[3] Harwell (1946-1950). Then he became *University Lecturer in Mathematics* at University of Cambridge (1950-60), *Prof of Electrical Engineering* at Stanford University (1960-1984) and Stanford emeritus (1984-1993).

His emigration in 1935 shifted his scientific interest from *pure mathematics* during his studies in Hamburg (1932-34, goal: school teacher) to *applied mathematics*, *physics* and *electrical engineering* in Manchester. After release from internment he joined the magnetron group of Professor *Douglas Rayner Hartree (1897-1958)*, working for the British Admiralty. The task was to achieve a better understanding of the generation of microwaves in a cavity magnetron, to design a device for efficient production of radar waves (i.e. special microwaves) of wave lengths which the German Luftwaffe could not jam because they did not know how to produce them. Mathematically speaking, they computed the paths of *many* charged particles (an electron beam) in a given electro-magnetic field of a cavity magnetron, taking into account that the moving charged particles generate fields themselves. The resulting field is called a *self-consistent* field. One of the equations to be solved again and again was the *Poisson equation*. By observing the particles timestep by timestep, he discovered the 'threshold' criterion for magnetron operation, later on an important design tool.

This was a paid job. Thus he could afford to get married. In June 1942 he married Mary Frances Behrens (*1921) of the well-known mercantile family Behrens of Manchester. They had two sons: Oscar Peter (*1943 in Manchester, now FRS) and Michael (*1945 in Berkeley).

The scientific expertise he gathered in the magnetron group had a deep impact on all of his subsequent scientific life. When the work of the magnetron group came to an end, Professor *Mark Oliphant (1901 - 2000)* invited him to join his group in Berkeley to work on 'ion optics', i.e. on the electro-magnetic separation of uranium isotopes with the CALUTRON *(California University cyclotron)*. In a cyclotron, charged particles move on circles. The radius of the circle depends on the mass – different isotopes move on different paths. Thus he probably computed there again paths of charged particles (ions) in their self-consistent fields.

When the Manhattan Project came to an end in the summer of 1945, it seemed clear to him that he would continue to work in the field of nuclear research. He and his wife considered several different job offers, in the US and in the UK. The offer from Profs Peierls and Oliphant to work with their team at University of Birmingham was turned

[3]AERE - Atomic Energy Research Establishment

down by the couple: the salary seemed too low to support a family with two children. He accepted the other UK-offer and joined the team led by Profs *John Cockroft (1897 - 1967)* and *James Chadwick (1891 - 1974)* for the *Canadian and British Atomic Energy Projects*.

This project was started in the late thirties in England, moved to Montreal during the war, but was not intensely pursued during the Manhattan project. After the war it was intensified in Montreal, and its return to England was planned in Montreal. It was clear that it would be too dangerous to do this work at a university in the middle of a city. So it was decided to found the new site *AERE Harwell* in the countryside between Oxford and Reading, far enough away from a place with dense population, but close enough to a university for using their facilities (library, lecture halls, hospitals etc.) and to a military airport.

According to the public records in *The National Archives* [NaAr], while at Harwell Buneman did (secret, military) research on nuclear energy, fission and fusion, analytic and computational, and shared his knowledge in internal reports (two of which were declassified and published as articles in scientific journals later on) and in two series of lectures: four lectures on pile theory (1946) and seven lectures on *'Scientific and engineering problems of nuclear power'* (1949). In his reports he mostly dealt with pile theory, i.e. with devices for gaining energy from fission of heavy nuclei like uranium. But he also dealt with magnetron theory again (1948) and with *'The use of large-scale computing facilities in the theoretical analysis of light nuclei'* like the hydrogen isotopes which are important for fusion (1950).

In 1948 Bunemann was unhappy about his working conditions and about the topics of his work. He felt that *... 'the possibility of making "fundamental contributions" in pile work and the scientific appeal of the work (limited in any case by the continued security restrictions) is decreasing rapidly' ....* He would have preferred to fully concentrate on the newly evolving field of plasma research and fusion. [buneman-papers, Original and copy of a typewritten letter]. Also, the private life of families was very much restricted by the military and uncomfortable at Harwell: they had to live in prefabricated houses, *'tiny tin boxes'*, which gave the place *'the general appearance of a penal colony.'* Mary had a massive re-entry culture shock and remembered later: *'Never before had I felt so humiliated nor so homesick for the wonderful, convenient United States'.* The couple separated during their Harwell time and got officially divorced in September 1951. They both got remarried shortly afterwards: Mary in Oct 1951 to *Brian Flowers, Baron Flowers, FRS (1924 - 2010)* and Oscar to *Ruth Eades (*1929)* in April 1952. The children of his first marriage lived with their mother and stepfather in England, but stayed in contact with their father. The children of his second marriage are Kevin (*1953) and Paul (*1956), both born in Cambridge.

The head of his department in Harwell was *Klaus Fuchs (1911 - 1988).* When Klaus Fuchs was uncovered as a spy, security regulations were severely increased, and several people were advised to leave AERE. Among them was Oscar Bunemann. He became university lecturer for mathematics at the University of Cambridge and a member of Peterhouse. His scientific interest, however, stayed in theoretical physics, especially in fundamental and cosmical electro-dynamics and the newly evolving field of plasma physics (cosmic plasmas, fusion plasmas).

In the academic year 1957/58 he spent a sabbatical at Stanford University. During this stay he had access to the biggest and fastest computer of the time, a Univac 1103AF. Extending the numerical methods employed earlier, he did a *first* numerical simulation of a plasma, computing paths of the same number (256) of positively and negatively charged particles in a self-consistent field. Thus he discovered an electron-ion instability, called the *Buneman Instability* today, and he showed how anomalous resistivity comes about. The publication of these results [Bun59] immediately got much attention and was frequently cited. This work probably also helped him to attain a full professorship at Stanford University.

25 years later, in 1984, this article was declared a *citation classic*[4] [Bun84]. Later on he remembered [Bun90]: ... *'the publication of two pages of graphic computer output in Physical Reviews, showing electron and ion space-time orbits made quite a stir'*. If we look up the paper [Bun59] in the ISI World of Science citation index [WoS, Jun 2014] now, we find that the paper is still highly cited: 424 citations in the first 25 years (1959 - 1984), 194 citations in the next 25 years (1985-2010), 8 citations in 2014, and 671 citations in total from the Web of Science Core Collection.

In the years 1960 - 1984 Buneman was Professor of Electrical Engineering at Stanford University, heading the Institute for Plasma Research (SUIPR) and cooperating with colleagues in the Bay Area (Stanford, Berkeley, Livermore) and elsewhere. Besides his other work he continued research in numerical simulation of plasmas (laboratory plasmas and cosmic plasmas), not only in one spatial dimension as in [Bun59], but later on also in two and three spatial dimensions, with growing numbers of particles. Treating as realistic mathematical models of plasmas as possible, it was -and is- necessary to use the biggest and fastest computers – they were available in the Bay Area – and to develop new and more efficient computational methods.

His main interest was in investigating plasmas. But whenever necessary, he dealt with many different problems of computer science and numerical analysis. Thus, for instance, he also dealt with fast and multi-dimensional Hartley transforms, certain types of finite elements, and he replaced certain functions of Cray software by his own, more efficient routines. In the sixties he and his PhD student *Roger Willis Hockney (1929 - 1999)* were strongly involved in the development of numerical methods closely related to the Fast Fourier Transform, together with *Gene Golub (1932-2007)* [Hock66a]. Buneman became well-known among numerical analysts for his *Fast Poisson Solver* [Bun69, BGN70, Hen74, SB78], the *Buneman algorithm*.

At the time when it still was cumbersome and time-consuming to generate computed pictures using plotters, i.e. programmable machines for drawing lines with ink-filled pens, Buneman produced computer-generated pictures on printers as well, by using digits and letters as pixels. It seems that Roger Hockney was the first to produce a film of moving plasma particles [Hock66b, IV. Making the film]. After Hockney left SUIPR, Buneman himself started to run Fortran codes and showed movies of his numerical simulations during his talks at international meetings and summer schools. Soon other plasma physicists around the world started to display their numerical results in movies. And then this technique spread to other fields, as did the particle methods.

[4] 'A Citation Classic is a highly cited publication as identified by the Science Citation Index' [...] [Gar, Jun 2014]

In 1984 Buneman became Stanford emeritus. He joined Stanford's STARLab and continued his research as before. He died on January 24, 1993. His plenum talk planned for the IEEE 1993 plasma meeting was replaced by a memorial session for him, with a talk by his colleague Bruce Langdon [Lan93]. For more details see [Bun90, Stan93, Lan93, BBP94, MSp12, MSp14] and the references therein.

2.2 Patronages

Buneman's scientific career was made possible by patronages of various persons and institutions: When he left school, his school awarded him some money for being the *Primus Omnium*. After his father lost his position because of the difficult economic situation in 1932, the University of Hamburg waived about half of his semester fees.

When Oscar and several friends were arrested in April 1934 for their anti-Nazi activities, his father together with the lawyer (Dr. h.c.) Hans Harder succeeded in moving all arrested friends from the concentration camp located in a building formerly used by the Fuhlsbüttel prison to a regular pre-trial custody in the neighbouring prison. They then had a 'regular' trial, based on a law from 1933 that was declared null and void in the fall of 1945. While he was arrested, his family and several friends gave him compassionate support. Shortly before his release they arranged for him to be admitted to the Honours School of Mathematics at University of Manchester, *second year*. Even though he was foreign, he soon was in Manchester *the best man of the year*. As an undergraduate in Manchester, he was financially supported by an English friend of the family and by his parents. He graduated B.Sc. in 1937, with first class honours. In 1937 he was awarded the *Derby Mathematical Scholarship with Supplementary Grant*. He got his M.Sc. degree in 1938. He was then awarded the *Beyer Fellowship*. This was a considerable distinction as there were only two such fellowships awarded per year in the whole group of science subjects. Thus he never needed *financial* support from the SPSL. But he badly needed, and obtained, their support during his internment 1940-1941. This will be dealt with in Section 5.2.2.

2.3 Honours

He was elected Fellow of the American Physical Society (1948) and Fellow of the Cambridge Philosophical Society (1950). The *Buneman instability* commemorates his citation classic [Bun59] and the *Buneman algorithm* was dealt with in [Bun69] and is still cited in numerical analysis papers and used in plasma codes.[5] The dedication of the first text book on computer simulation using particles [HE81] reads: *'To Oscar, Founder of the subject'*. His achievements about communicating computed numbers in meaningful computer-drawn pictures, still or animated, are memorialized in the *Oscar Buneman Awards for the most insightful visualisation of plasmas*, with one prize in the still category and one in the animation category. They are presented at the International Conferences on Numerical Simulation of Plasmas, since the 16th ICNSP (1998).

[5] *Buneman trees* and the *Buneman-Levy algorithm* are named in honor of his son O. Peter.

2.4 Buneman's Nachlass

Buneman's nachlass, the *Oscar Buneman Papers (SC 0450)* were given to the Archive of Stanford University by his widow Ruth Buneman in 1993. Physically it consists of 35 boxes, 17 linear feet. Its scope is described in a summary as *Research notes, papers, reprints, correspondence, lectures, and class materials from his teaching career and research while at Stanford University, with some materials from the 1940s and 1950s relevant to his work on magnetrons. Subjects include plasma physics, fourier [sic] transformations, Cray computers, and poisson [sic] solvers. Papers also include films of computer simulations, tetrahedron models, and one file of personal documents.* A finding aid gives a short list of contents for each box [buneman-papers].

2.5 Plasma physics, particle methods, fast Poisson solvers and Fourier transforms

In the Sciences, the word *plasma* has several different meanings. In physics, plasmas are ionized gases containing balanced charges of ions and electrons. There are four different fundamental states of matter: solid - liquid - gas - plasma. As we know today, most matter in the universe is in the plasma state. The properties of plasmas vary widely: there are partially ionized 'cold' plasmas (as for instance in mercury arcs, vacuum tubes and tv plasma screens) and there are fully ionized hot plasmas (as for instance in the sun and in fusion experiments).

Important roots of plasma physics lie in astronomy and in research on gas discharges and ionised gases. Some of the milestones in the early years were:
the discovery of *helium* in the sun in 1868 and on earth in the following years; the discovery of α-particles (1896) and of α, β, γ radiation (1899); the discovery of the convertibility *matter - energy*, $E = mc^2$ (1905); the discovery that α-particles are nuclei of helium atoms (1909) and the first observation of a fusion process (1917); the speculation that the energy of stars is generated in fusion processes (1920) and its confirmation and theoretical explanation in 1929; the first controlled fusion in a laboratory by *Mark Oliphant* in 1934, with gain of energy; the definition of *'plasma'* from observations of oscillations in mercury arcs and the development of methods for measuring properties of plasmas (1928); the discovery of electro-magnetic fields in the sun (1908) and in interstellar space (1945-1949).

Oliphant's fusion experiment immediately generated much excitement about the possibility of using fusion processes of light atomic nuclei for energy supply. The discovery in 1938 that energy may also be gained by controlled fission of heavy atomic nuclei opened an additional possibility and led to the *Canadian and British Atomic Energy Projects* with both lines of research. But these projects were delayed by the war, compare the text on the Canadian and British Atomic Energy Projects in section 2.1. Surprisingly, those countries who had cooperated in the Manhattan project during the war did not cooperate or share their results on nuclear energy research in the years 1945 - 1958. Nuclear energy research was classified as national secret by the military of all former Allies. In 1958, at the second *United Nations International Conference on the Peaceful Use of Atomic Energy* in Geneva, fusion oriented plasma research was de-

classified by international agreement and free international exchange of research results was re-established.

Around 1950, various phenomena were known which had been observed in beams and flows of charged particles in electro-magnetic fields, but many of them were poorly understood. This generated a strong need for unification of knowledge and for development of theory. Plasma physics evolved as a new discipline of physics, with various mathematical models of plasmas: microscopic (particle trajectories), macroscopic (magneto hydro dynamics) and several others (e.g. Vlasov equations). With the new freedom of travel after WWII, there was much international cooperation *again* and exchange at meetings dedicated to subfields of plasma physics like 'cosmic plasmas' and 'magneto hydro dynamics'. Until 1958, the focus of the international meetings was on applications to cosmic plasmas and to gas discharges.

Magneto hydro dynamics is closely related to hydro dynamics and fluid dynamics: plasmas are special fluids having additional properties (electro-magnetic, thermal etc.). Experiments with fluids and plasmas show various types of instabilities, and the nonlinearity of their mathematical models (systems of partial differential equations) make it in most cases impossible to find exact solutions with paper and pencil. So plasma physicists and fluid dynamics researchers were in the vanguard of scientific computing as soon as computers became available.

Mathematical models for moving particles were developed first for studying the orbits of planets in a gravitational field (n-body problem). In the years after 1940, numerical methods developed for anti-aircraft ballistics and for studying the Bohr atomic model were extended in Hartree's magnetron group to study the trajectories of the particles in electron beams in electric, magnetic and electro-magnetic fields, as already briefly described in section 2.1. We also mentioned there that Buneman extended and further developed these techniques as needed for his ongoing research. More details are given in [Bun90, MSp12] and the references therein. In electron beams, all particles have negative electric charge. In plasmas, there are as many particles of positive as of negative charge, and their masses vary widely, by a factor of 1800 at least. Thus the length scales of their movements vary widely, which leads to multiscale problems and was and is a considerable numerical challenge.

Today, particle methods (PIC methods, mesh-free methods) are well-established computational methods. They are used not only in plasma physics, but also for numerical simulation of clusters of galaxies, of dynamics of molecules, of blood flow in small arteries, of electrons in semi-conductor devices, of carbon nano tubes, of the diffusion of pollutants in air or water, etc.. Moreover, they play a prominent role in generating computer graphics on play stations.

A sub-problem both in computational plasma physics and in computational fluid dynamics (and in many other applications) was the solution of the Poisson equation. Typically it had to be solved at every time-step. In some cases it would consume about 40% of the total computing time. Thus it was a great improvement to have a Fast Poisson Solver and the Fast Fourier Transform: faster numerical methods lead to higher productivity and allow to tackle more involved mathematical models describing the physics to be investigated for more realistic cases.

3 Young Oskar Bünemann

Oscar Bünemann was born on 28 September 1913 in Milan, Italy. His parents August Oscar Bünemann (1885-1958) and Elisabeth née Hüffmeier (1889-1957) both were citizens of Hamburg, Germany. They wanted to spell their son's first name in the German way, *Oskar*, but a 'k' was not allowed in Milan on a birth certificate [HH-Staatsarchiv, Schülerkarte]. During his years in Germany his first name kept changing between *Oskar* and *Oscar*. After he moved to England in 1935, his last name kept changing between *Bünemann*, *Bunemann* and *Buneman* in his documents and publications, until he changed his name unofficially in 1949 and officially in 1959 to *Oscar Buneman* [buneman-papers, Statutory Declaration of Oscar Buneman, Esq., 15 Dec 1959]. The abbreviation *OB* is used in this text for all variations of his name.

The Bünemanns were import/export-merchants based in Hamburg. In their youth they typically spent several years in foreign countries to learn trading there. They spoke several languages and they liked to play music and/or to sing, some of them professionally. OB's grandparents Bünemann first met in Havana on Cuba. His grandfather traded with cigars there. In Milan, OB's father had a drapery trade, while he traded with Scandinavian wood pulp after his return to Hamburg.

The Hüffmeiers used to be seamen and artisans and were very humorous. OB's grandfather *Emil Hüffmeier* was a civil servant (Verwaltungsbeamter), a member of the Hamburg parliament (Bürgerschaftsabgeordneter), and enthusiastic about the sciences. (see [MSp14] and the references therein).

OB's father August Oscar Bünemann grew up in Hamburg, had an apprenticeship in France and married Elisabeth Hüffmeier in 1910. The couple moved to Milan where Augusto Oscar traded together with an Italian partner. He spoke 13 languages, including Esperanto. In 1915, because of WWI, the family had to leave Italy very abruptly. So OB grew up in Hamburg. His parents organized their private lives for the advantage of their children Elisabeth (1911-1916), Oscar and Gertrud (*1920). When the children were young, the family home had a garden and was close to meadows and fields. It happened to be also close to the approach path of Hamburg's airport. Little Oskar was fascinated by the passing planes. In this he was encouraged by his grandfather Hüffmeier. He kept cultivating Oskar's interest in physics and technology over the years. (see [MSp14] and the references therein).

When the children grew older, their parents moved into the city. From 1924 to 1932 OB attended the famous *Gelehrtenschule des Johanneums* (founded in 1529 by a friend of Martin Luther). The languages offered in this school were English, French, Latin, Greek and Hebrew. Oskar learned English, French, Latin and Greek at school, and privately in addition Esperanto. [MSp14], [spsl-ob, fol 353]. He finished this school in February 1932 with the German Matriculation Examination. Because he was the best of the year, the Johanneum awarded him a first prize (1. Prämie) [HH-Staatsarchiv, Schüleralbum, Regelmässige Oster-Reifeprüfung 1932].

In April 1932 he started to study mathematics and physics at University of Hamburg with the goal *Ph.D. exam and Teacher's exam* [Zentrum]. The course of his studies at U Hamburg is documented quite well because his *Studienbuch* (in Hamburg called *Anmeldebuch*) is kept in the collection [buneman-papers]. For the first two semesters

he followed the standard path. During the following two semesters he also took the standard courses, but in addition several other courses, as for instance one on aviation medicine (Luftfahrtmedizin). And he joined the university flying club (Akaflieg) [spsl-ob, fol 353]. In addition, he attended courses by *Prof Emil Artin (1898 in Vienna - 1962 in Hamburg)* designed for much more advanced students, Algebra II and the research workshop *Arbeitsgemeinschaft*. He also had private contact with Emil Artin, they played and listened to music together [gertrud].

The Nazis came into power on Jan 30, 1933. Though they could not be as active and aggressive in the internationally open Hanseatic city as they were in Munich, the consequences of Nazi rule were felt immediately. In the summer of 1933, OB served in a Labour Camp for 3 months. After that he started underground political activities (fol 353) which were detected in April 1934. He was arrested and sentenced to 18 months of prison. During OB's time in investigative arrest and in prison, Prof Artin provided mathematical problems *'to while away the dreadful hours of his solitary confinement'* [michael].

When he was to be released in September 1935, a passport was granted to him so that he could leave the country legally [spsl-ob, fol 353]. While his release from prison was approaching, his family and friends prepared his departure to England. He began to study in Manchester in October 1935.

4 OB in Manchester

Formally speaking, OB was not a refugee. This, together with the facts that he left Germany as a young student who received the main part of his mathematical education in England and that he moved from applied mathematics to physics and electrical engineering later on, probably explains why his name is not given in any of the lists [RSS09, Rid84] etc of German speaking mathematian or physicist emigrants.

OB left Germany in a regular way, with a fresh German passport. Upon his arrival in England in Oct 1935, he was welcomed by *Mr. Joseph William Ison* of London who had invited him and who made himself responsible for OB to the Immigration Officer. Thus OB was granted a permit of stay for the time of his studies in Manchester (Alien's Certificate 51754). Mr. Ison also paid the tuition and university fees for the first two years. [spsl-ob, fols 353 & 376]. In addition, OB's parents sent him a small monthly financial support (RM 40.-) [gertrud]. Officially, OB thus left Germany in the traditional style of his family [MSp14], profiting from the social network of this mercantile family and also from the Esperanto contacts of his parents.

Mr. Ison had visited Hamburg in 1933. He met the Bünemann family through OB's grandfather Emil Hüffmeier and had maintained contact with them by correspondence and visits since then [spsl-ob, fol 376].

4.1 His first years in Manchester

Why did OB go to *Manchester*? While OB was in prison, his parents contacted Prof Artin and Mr Ison about their son. Prof Artin suggested that OB should continue his

studies with Prof Mordell in Manchester. He also wrote a letter to Prof Mordell, assuring him that he would find in OB a very cabable student who would be able to continue his studies at a very advanced level [gertrud, michael, spsl-ob]. And OB's parents visited Mr. Ison in London. He strongly recommended that OB should leave Germany and come to England. He personally arranged what was necessary so that OB could study in Manchester. [spsl-ob, fol 376]. Letters dated 23 Sept and 27 Sept 1935 arrived in Hamburg from England[6] that OB was accepted as a student [buneman-papers].

At Manchester University, OB's main contact persons during the first years were Prof Louis Mordell (Fielden Chair of Pure Mathematics (1922 - 1945)) from the US and Prof Blackett (Langworthy Professor at the School of Physics and Astronomy (1937 - 1953); Nobel Prize in Physics in 1948) and Prof Hartree (Beyer Professor, Chair of Applied Mathematics (1929-1937); Chair of Theoretical Physics (1937-1945, on leave 1940-45, Ministry of Supply); Professor of Engineering Physics (1945-46); Chair of Mathematical Physics, Cambridge U (1946 - 1958)) [CFF03] from the UK.

Prof Hartree wrote later [spsl-ob, fol 369, 27.1.41]: *'my knowledge of him dates from Oct. 1935, when he entered the University' [...] 'I have known him not only in his work as an undergraduate and post-graduate student, but also in more informal ways, particularly in connection with musical activities both in the University and at home.'*

Mary, daughter of (Sir) Leonard Behrens, remembers: *'Two of my father's friends who occupied chairs in Manchester University influenced me greatly. One was Patrick Blackett. Although this handsome, thoughtful-looking man had been trained as a Naval Officer and had never taken a degree, he was an academic of the highest distinction. He was also staunchly left-wing. After the war, like so many, he became disillusioned with his early Marxist convictions and joined the Labour Party. Subsequently he won a Nobel Prize, and late in life became President of the Royal Society and an adviser to Government, was awarded the Order of Merit and a peerage. Another was the Hungarian immigrant, Michael Polanyi, a physical chemist turned political philosopher, and a great seeker after truth. His early training had been in medicine and his attitudes were so right-wing by comparison with Patrick's that their wives used to contrive to make sure that when they travelled to meetings in London it was not on the same train.' [...] 'Although I visited the Blackett's house far less frequently I decided that Patrick's approach to politics was the one for me. Michael was always known as "Mishi".' [...] 'Despite their ideological differences, both Patrick and Mishi detested what was going on in Germany and gave freely of their hospitality to refugee students. Oscar was among those they were concerned for.'* [mary09, p. 8f] Also Mrs. and Mr. Ison supported OB socially by *'making him a member'* of their family, *'and he has learnt to lean on us, and to consider our home his own, having been constantly in touch with us and having spent many of his vacations with us.'* [spsl-ob, fol 376].

Besides these hospitalities, OB also found several new friends: since 1936 he was *a constant and welcome guest* at the house of Arnold Watson and his wife in Southport. They took him with them on holidays and weekend walks, and Mrs. Watson accompanied him when he played his violin. [spsl-ob, fol 374]. At the university OB met Mary Behrens and got into contact with her family. Several of Mary's ancestors

[6] from the Joint Matriculation Board of the Universities of Manchester, Liverpool, Leeds, Sheffield and Birmingham

were German: her great-grandfather Sir Jacob Behrens (1806 - 1889) was born in Germany to a Jewish textile-making family. He moved to England in 1834. There he founded the company *Sir Jacob Behrens & Sons Ltd.* and thus became one of the founders of the Bradford wool textile industry. His eldest son Gustav married *Fanny Warburg* from the famous Warburg banking family of Hamburg. Their youngest son *(Sir) Leonard Frederick Behrens* was the father of Mary. [michael]. Besides his job in the company of his family, Leonard Behrens, M.Com., was engaged in other activities: he was J.P. (Justice of the Peace) [spsl-ob, fol 363], involved in the management of the Manchester symphony orchestra, *The Hallé Orchestra*, (as well as his father Gustav) [gertrud, michael], and by convocation he was appointed to the Court of Governors of Manchester University [The Serpent, vol 23, Nr 8, p.132].

When OB's parents and his sister Gertrud (*1920) visited him from Hamburg, they stayed with the Watsons. Arnold Watson remembered *"The father is a most cultivated man and the sister (18 or so) looked like becoming a concert pianist."* [spsl-ob, fol 374, 7. Febr 1941]. And Gertrud remembered in 2013 the excellent facilities to stay there overnight, but no other details. She was much more impressed by their visit to Leonard Behrens and his wife, by Leonard's exceptional personality in an impressive house (Netherby) with a beautiful garden. "We three Bünemanns got very quickly into close contact with Leonard, regarding language, culture, open-mindedness and cosmopolitan view of the world. He invited me spontaneously to play on one of his two pianos. Finally we played together a concerto for two pianos in e-minor by Bach," .... [gertrud]. Thus OB was well integrated into the local English society.

In addition, he had several other activities: As A.R.P. (Air Raid Precaution) Service he was Fire Watcher at Manchester University until May 1940 (fol 367), and together with Mr. Wild, a friend of the Watsons, he had a correspondence with the A.R.P. Dept. of the H.O. with suggestions how shelters could be strengthened [spsl-ob, fols 367 & 374]. To improve his very small financial means during the first years, he occasionally gave private lessons, and he played his violin in some smaller restaurants where German-Jewish emigrants used to meet [gertrud].
"I also know of things he has done here, helping student activities, and the 'Aid to Finland' fund a year ago, which seems to me evidence of a real desire to help the ideals for which this country is fighting." [spsl-ob, handwritten letter by Hartree, 27 Jan 1941, fols 369-370]. Probably Hartree was alluding here to the "Finnish Aid Bureau" which was set up in early 1940, i.e. in his terms "one year ago". OB had apparently contributed to their fundraising. [7]

OB also gave lectures on the subject *"Inside Nazi Germany"* within the W.E.A. Youth scheme (Oxford Road, Manchester) and he published some small articles in students' magazines, for instance in *The Serpent*. [spsl-ob, fol 367] Mary remembered in 2013 that her father Leonard always appreciated when she showed him related information material [michael].

[7] The USSR attacked Finland Nov 30, 1939 (counterbalancing the German presence in Poland, cfr the Molotov-Ribbentrop pact) and was expelled from the League of Nations Dec 14, 1939. At the same time, the League of Nations called for aid to Finland. Many countries responded. The "Finnish-British Association" (then headed by Professor H. W. Donner) collected funds in Britain for aid to Finland. For more details see [Rob06].

The Serpent (1917-1956) was the official Magazine of the Manchester University Unions. Many issues are available in the University of Manchester Publications Collection, UMP 2/4. It published an eclectic mix of contents:
* poems by well-known writers and by students (one of them became famous later: Anthony Burgess (1917-1993), student of English literature in 1937-1940, author of 'A Clockwork Orange');
* 'The Manchester University College Song', to the tune 'Wein, Weib, Gesang', vol **21** (Nov 1936 - April 1937), p.118;
* a narration describing the fears of an emigrant while he was leaving Germany by train in an unlawful way during the Nazi time (with a much higher amount of money than was allowed). Border police arrested the other person in the same train compartment;
* reports on a skiing vacation in Switzerland or a hiking trip in the Alps in the summer resp.;
* essays on the attitude of scientists; Fascism in Spain; the lacking beauty of Manchester compared to the home city of the writer; etc. and
* university news like
- 'Mr. T.G. Cowling, M.A., D.Phil. (Oxford) got an appointment as Lecturer in Mathematics', vol **22** (July 1937 - Summer 1938), p.154;
- 'The following appointments to the Court of Governors have been made by Convocation: Mr. Leonard F. Behrens,' ..., vol **23** (Autumn 1938), p. 132;
- the number of students in 'this session' will be 2496 (men -160, women +25 compared to the last session). vol **24** (1938 - 1940), p.21.

Of many entries it is obvious that they were written by some immigrant (though in good English: some of them were probably corrected by the editors to prevent easy identification). Clearly more than half of the entries were not signed by full names but by two letters (like 'A.G.'). At least in one case it was admitted in a later issue that one (often occurring) name of the few full names was also an alias. This was when this person became one of the editors. For sure the article [AG37] was written by OB [spsl-ob, fol 367], probably also the articles [AG38a, AG38b]. [AG37] is organized as a discussion among friends, contrasting Germany as seen with the eyes of tourists (Olympics 1936) with frightening experiences of local people.

4.2 Studies and research in Manchester

OB began to study under Prof Mordell in Manchester in October 1935. Because of his former studies in Hamburg, he could enter the Honours School of Mathematics, *second year*. Soon he was the *'best man of the year'. He graduated B.Sc. in 1937, being placed in the first class in the final Honours list.* [buneman-papers, Hartree, 5.5.1940] In 1937-38 he was awarded the Derby Mathematical Scholarship, with supplementary grant (£ 30.-+40.- per annum). [buneman-papers, documents for both]. M.Sc. in 1938 with a thesis on stability theory for ordinary dynamical systems [Bun38]. This research was accompanied by two publications [Bun38a, Bun38b]. A short communication about the contents of [Bun38b] was read during the Ordinary Meeting of the Manchester Literary and Philosophical Society on Feb 15th, 1938 [Mem. Proc. Manchester Lit. Phil. Soc. **82** (1937-1938), p.ix]. He was awarded the Beyer Fellowship for 1938-9, (£ 100.- per

annum). As remarked earlier, this *'is one of two fellowships awarded each year in the whole group of science subjects, and is a considerable distinction.'* [spsl-ob, Hartree, fol 369].

OB's work for the M.Sc. degree was on the theory of vibrations of dynamical systems with non-linear characteristics. This was formally done under Prof Hartree's direction, *'but was in fact much more nearly an independent piece of work than most work done in a first post-graduate year. This work did not lead to any important new results, but was an able survey of the subject with some additions to previous knowledge, and showed a good grasp of technique, unusual maturity of thought and judgement, and a good sense of the relation between a practical physical or technical problem and the mathematics appropriate to its investigation.'* wrote Hartree in his letter [spsl-ob, fol 369, 29 Jan 1941]. Hartree also stated in that same letter: he *'was, I suppose, the most able student we had in the Mathematics Department during the 10 years I was on its staff.'*

Note that OB changed advisors, from Prof Mordell to Prof Hartree. This meant a move from Pure Mathematics to Applied Mathematics. This change was commented by both when they wrote letters of recommendation for him in May 1940: *'Mr. Bünemann is an extremely competent and keen mathematician who did very well in his examinations. He has extensive mathematical interests though he has specialised in his research work on aspects of applied mathematics. He took physics as his subsidiary subject and has maintained his physical interests in connection with his advanced work.'* [buneman-papers, letter of Mordell, 7th of May 1940]. *'Both his undergraduate and later work have been marked by freshness, rigour, enterprise and originality. Beginning with a bias towards pure mathematics, from his previous studies, he has developed an interest in the application of mathematics to scientific and technical problems, and, in addition to his main subject of research, he has tackled with success several smaller problems of a definitely practical nature.'* [buneman-papers, letter of Hartree, 5th May 1940].

On 21st Nov 1938 the *General Board of Faculties, Science and Technology Section, 'accepted an application from Oscar Buneman for Ph.D. Study.' ... 'He proposed to carry out research in aerodynamics for 2 years, supervised by Professor Hartree and Mr. Squire.'* [Peters]. OB submitted his thesis in April 1940 [spsl-ob, fol 356]. *'On May 3, 1940 the commitee accepted an application to examine his thesis "Solutions of the Spheroidal Wave Equation". The internal examiner was to be Mr. Squire, and the original external examiner was Dr S. Goldstein, although this name had been crossed through. The reserve external was Dr Cowling.'* [Peters]

Now OB started to apply for teaching jobs, supported by those letters of recommendation from Profs Hartree (May 5th) and Mordell (May 7th) which were already cited for remarks on his mathematical abilities and on his move from pure to applied mathematics.

Mordell: *'He should make a very good teacher as he is a clear expositor. He takes an active interest in his surroundings, is thoroughly alive to them and has a wide outlook. He has initiative and sense of responsibility. He should prove useful in any school even apart from his teaching. I should like to support very strongly his application for a teaching post.'*

Hartree: *'His command of English is excellent, and his presentation of his work is clear.*

In addition of his command of his subject, he has an appreciation of the possible difficulties of those less well-equipped than himself, and I would expect him to be a good teacher, both sound and interesting, at any stage of the subject.

He has wide interests outside his work, and, among other things, is a capable violinist. Personally, he is sociable and easy to get on with, and would be an acceptable colleague. I can wholeheartedly him for any post, either research or teaching, for which he may apply.'

Also his Stanford students in later years praised the clear, mathematical presentation of the subjects of his lectures and that he was an extremely nice person [MSp14].

On June 3, 1940 OB was interned in Manchester [spsl-ob, fol 366]. His oral examination was scheduled for June 8, 1940. When the committee met for his oral on June 8, it *'noted that Buneman had been interned and queried whether an examiner could be sent to hold the oral at "the place of internment" as it had been indicated that he would not be released to attend the oral. His name was not mentioned in any subsequent minutes, and the degree is recorded being awarded in 1942.'* [Peters]. The official document for his degree is kept in the collection [buneman-papers]. It is dated 1 May 1942. But in practice the degree was granted to him 'in absentia' in the summer of 1940 [spsl-ob, fols 358-360].

When he enrolled at University of Hamburg in 1932, his goal was 'PhD exam and Teacher's exam' [Zentrum]. It seems that no Teacher's exam was necessary under British circumstances. But he stuck to his intention of becoming a teacher. *Why?*

Because he was impressed so much by his former teacher *Prof Dr Benno Diederich (1870 - 1947)* at the Johanneum in Hamburg? Diederich was a very imposing personality, liked by his pupils. Besides his teaching he also was a writer, and he gave private and public talks about literature and arts in Hamburg. [gertrud, 2013], [de.wikipedia, Benno Diederich, 16.2.2014]. When Samuel Beckett visited Hamburg in 1936, he met Diederich at a literary salon, visited him at his home and wrote about this in his diary [Quad06]. The Bünemann family and the Diederich family happened to live in the same house (Papenhuderstrasse 32) for several years. When OB was imprisoned in 1934, Diederich wrote a letter of recommendation for him which seems to have impressed the five (!) professional judges of the trial. Eight young friends were sentenced in the same trial, 6 male and 2 female, among them two students, the Jewish Kurt Mehrgut (24 months) and the non-Jewish OB (18 months) [buneman-papers, Text by Diederich, 22 Aug 1934; Gerichtsurteil des OLG Hamburg, 3rd Sept 1934].

Or was the main reason for OB to seek employment as a teacher that nobody offered him a university position? It seems that it was quite disadvantageous for him that he had chosen Mr. Squire as his advisor. Probably he did so because he was so fond of flying, since his early childhood. (see sections 3 and 5.2.2)

5 Internment of enemy aliens, assistance given by the SPSL

5.1 Internment in general

In times of war, governments tend to view foreign nationals with suspicion. It has been, and still is, common practise to detain citizens of enemy nations without trial. Great Britain has been no exception in this respect. During both world wars, British authorities rounded up and interned thousands of citizens of enemy countries, as well as some of its own citizens under suspicion of collusion with the enemy. More recently, during the two Gulf wars in the 1990s and early 2000s, people were also held without trial on the assumption that they might otherwise aid the enemy, as discussed in [CK93].

The internment of enemy aliens in Britain in 1939 and 1940 was without trial, although each case was examined by a local tribunal. The legality of such detention was repeatedly challenged at the time, to little effect. Before the outbreak of war, the government had prepared wartime Defence Regulations under which British nationals could be detained without trial if suspected of planning to or actually aiding the enemy. Detention of foreign nationals could in principle proceed by Royal Prerogative, i.e. the executive power vested in the government by the sovereign, although the archives cite the Defence Regulations in many of those cases too [Koe42, Hol93].

Detention without trial flies in the face of *Habeas Corpus* as well as the civil liberties afforded by the English Bill of Rights. No wonder, then, that a controversy erupted in Britain in the summer of 1940, when the trickle of detentions of known and suspected Nazi colluders during the previous winter suddenly turned into a wave of wholesale rounding up of thousands of German, Austrian, and Italian nationals. Churchill is reported to have quipped "Collar the lot!"[GG80] after Italy declared war on Britain and France on June 10, 1940. The tragedy of the S/S Andorra Star [sic], which was sunk by a German submarine on July 2 with hundreds of Italian detainees destined for a Canadian internment camp on board, no doubt contributed to sway public opinion. The heated public debate of that time is documented in e.g. [Laf40, Sim94, Chr09, Ste80]. The matter was also debated repeatedly in the House of Commons, on July 10 and August 22, by which time government policy had reversed [Dov05]. In the end, moderation prevailed, and most of the detainees were released within months, although some remained interned for several years.

Many grantees of the *Society for the Protection of Science and Learning* (SPSL) were among the interned enemy aliens in Britain in 1940, and the Society devoted considerable effort to pleading with the authorities for their release. It should be noted that the Society initially took the position that its grants to refugee scholars would be discontinued during their internment, in an attempt to shift financial responsibility over to the government or other relief organizations, the Jewish Refugees Commitee in particular [Nos12]. While this manoeuvre contributed to exacerbate an already very difficult situation for some of these refugees, there can be no doubt that on the whole the SPSL contributed significantly to the early release of many refugee scholars from internment. Its assistance to OB is just one example. During the years 1933-1945 the Society took care of 2541 emigrants in various ways. About half of them were from

Germany and Austria [Scher01, p.124].

A substantial part of this work was done by Ms. Simpson. Esther (Tess) Simpson (1903 in Leeds - 1996 in London) studied German and French at University of Leeds in 1921-24. Privately she also learnt stenography and enjoyed to play the violin. After her exam in 1924 she spent a short time in Breslau, Germany and then moved on to Paris, earning money with translations and work as a secretary. In 1927 she took a position at the 'International Fellowship of Reconciliation (IFOR)' and moved with them to Vienna. She very much enjoyed the years 1928-33 in Vienna, playing and listening to music, and having many intellectual friends. Several of those Vienna friends she met again later on, as emigrants in the UK [Scher01, p. 124]. While working for the *World Alliance of YMCA's* in Geneva, she was invited to come to London to work for the ACC/SPSL. She accepted, although there she would earn only one third of her salary in Geneva. She retired in 1978 but stayed in touch with 'her family'. For more details see [MP96] and [Coo92].

The Society was founded in 1933 and is still active. In April 1933, while on route to Vienna, *(Baron) William Beveridge (1879 - 1963)* established the *Academic Assistence Council (AAC)* when he learnt of the Nazi authorities' dismissal of a number of leading professors from German universities on racial and/or political grounds. A founding statement was produced in May 1933. And in October 1933 ten thousand people attended an AAC event at the Albert Hall. In 1936 the AAC changed its name to the *Society for the Protection of Science and Learning (SPSL)* [cara, history]. After 1945 the SPSL has remained active, helping scientists in trouble around the world. As time passes, the focus of SPSL is shifting again and again - as it is needed according to the changing political troubles in various regions of the world. In 1999 the Society changed its name to *Council for Assisting Refugee Academics (CARA)*, and in 2014 to *Council for At-Risk Academics (CARA), reflecting the fact that CARA helps many who are not 'refugees'* [cara, history].

The internment of enemy aliens in Britain has so far not attracted a great deal of attention from historians of belligerent conflict, and the topic has generally, perhaps not unreasonably, been regarded as a sideline to the main narrative of the two great wars of the twentieth century. There can be no comparison with the callousness and cruelty of the internment, deportation and extermination policies of Britain's enemies in the Second World War. For scholarly studies of the detention of both British nationals and enemy aliens in wartime consult e.g. [Wil11, KC92, Sim94, Thu94, Koe42].

In 1991, the UN High Commissioner for Human Rights established the *Working Group on Arbitrary Detention (WGAD)* with the mandate

∗ to investigate cases of deprivation of liberty imposed arbitrarily or otherwise inconsistently with the relevant international standards set forth in the Universal Declaration of Human Rights, and

∗ to assist UN member states in preventing and guarding against such practices.

Sadly, the abolition of arbitrary detention practices seems not to be near at hand, and at the time of writing the mandate of the WGAD has just been extended for another 3-year period.

5.2 Internment of OB

Our information about OB's internment stems from the files of the SPSL [spsl-ob] and from remarks, anecdotes and reports of others. OB had been introduced to the SPSL in Oct 1938 by Prof Blackett who wrote a letter to Ms Simpson asking her to send a questionnaire to OB and to Dr Janoussy, a Jewish physicist from Hungary. No questionnaire is contained in OB's file, but a Curriculum Vitae and an accompanying letter, mentioning a letter from SPSL dated 20 May 1939. OB's answer is dated May 24th, 1939 (fols 353-355).

OB's case as an enemy alien resident in Britain was first considered at a hearing of a local Tribunal in Manchester around October 9, 1939, with Prof Hartree, Prof Mordell and Mr Ison in attendance. As a result, OB gained unrestricted freedom of action, i.e. he was classified as 'friendly enemy alien, Category C' [spsl-ob, fol 376]. As a category C alien, he remained free until the wave of internments in May/June 1940, which affected nearly all resident citizens of enemy nations.

OB was interned in Manchester on 3rd June 1940 [spsl-ob, fol 366] and was released with substantial help of the SPSL shortly before 5th May 1941 (fol 386). We do not know much about his life during internment because he did not tell much about that time. His second wife Ruth, whom he first met in 1950, wrote in an email: *'He never talked to me about his time in Manchester and about his internment. I believe he wanted to make the most of the present and the future. He concentrated particularly on his ongoing research.'* [ruth, 2013].

The main stations of his internment were the Isle of Man and then Canada [mary09], A.I.C. Huyton, Liverpool [spsl-ob, fol 359, Jan 1941], and 6, Hutchinson Internment Camp, Douglas, Isle of Man [spsl-ob, fol 382, 8 Mar 1941].

His first wife Mary who had contact with him directly before and after his internment, told their son Michael that *'during their Montreal time'* [i.e. between the fall of 1945 and the spring of 1946, see [MSp14]], *'they drove past the camp where Oscar had been interned, but did not visit it.'* [michael, 2013].

5.2.1 A group of companions and a 'camp university'

Some years earlier, Mary wrote: ... *'For Oscar this period was particularly difficult. There were so few non-Jewish refugees that there was a strong probability that the authorities would not understand his position and would treat him as a Nazi sympathiser, and as such a prisoner of war. (A few such people, unable to get home at the beginning of the war, had already been interned.) He applied successfully to be admitted to an enclosure reserved for orthodox Jews, and the fact that he obviously wasn't a member of that fraternity escaped the notice of the camp officers. The official bungling has since been excused by a story that the papers explaining the nature of the shiploads of human cargo (and some actually did travel in the hold), were lost when a ship called the* Arandora Star *was torpedoed together with some of the unfortunate individuals concerned.'* [mary09, p.13f]. And Thomas Gold remembered: *'He was a marvelous companion in those trying times. He was one of the very few non-Jewish refugees from Nazi oppression in the camp. Evidently he had strong principles and saw the Nazi hell that was being created.'* [BBP94].

There is strong evidence that Klaus Fuchs (*1911 in Rüsselsheim), Paul Weiss (*1911 in Sagan/Zagań, Silesia), Oscar Bünemann (*1913 in Milan), Max Perutz (*1914 in Vienna), Walter Kellermann (*1915 in Berlin), Hermann Bondi (*1919 in Vienna) and Thomas Gold (*1920 in Vienna) were interned together for quite some time. Max Perutz reported about a camp university with participants Herman Bondi, Thomas Gold and Klaus Fuchs [Per85]. Thomas Gold told that OB *'and (Sir Herman) Bondi were the prime movers in the camp university and I certainly learned a lot more from them than I would have had I remained in Cambridge for those nine months'* [BBP94]. Kellermann wrote that he and Fuchs taught at the camp 'university' and that he met Herman Bondi during internment [Kel10]. Thus we may assume that we get quite a realistic picture about the circumstances OB went through by reading [Per85, Kel10, Gold78] and [MP01, Chap. 9]. Illustrations and personal accounts by former internees are also to be found in the Canadian Virtual Museum [VMC].

How many participants did this camp university have? Sometimes they were just two or three teaching each other from memory and through sophisticated mathematical puzzles, sometimes they had lectures attended by maybe up to 20 persons [Gold78]. Paul Weiss wrote in a letter to Ms Simpson in 1946 that he taught a lot of mathematics during internment and that in Canada he helped to organise the camp university [SPSL, fols 228-228v in file MS SPSL 286/2, fols 181-240]. *'Some of these hastily formed, and ill-equipped places of isolation' ... 'became, in spite of revolting conditions, excellent breeding grounds for budding scientists, and there were many distinguished academics who owed their initial inspiration to the tuition and discussion arranged to break the tedium and hardship of their enforced detention. Herman Bondi was one.'* [mary09, p.13]. The biochemist Max Perutz reported that he got interested in astrophysics from contact with a fellow internee: on one of the first days, while they had to sit somewhere for hours, just waiting that something was going to happen, the guy sitting next to him kept staring at a white sheet of paper. After a while he started to talk: 'look, there is a litte hole in the paper. If you hold the paper like this and look through that hole, you can observe sun spots.' [Per85]. It seems that also OB's interest in astrophysics (and plasma physics?) started during internment. Ruth later told: *'He taught me a lot about the stars. Moving from Germany to England to Canada as a young man, he felt it was wonderful that the stars were constant.'* [Stan93].

Though all of them were interned around the same time, i.e. in May/June of 1940, the dates of their releases varied widely. Fuchs, Kellermann, Weiss and Perutz were released upon arrival in Liverpool mid of January 1941, OB beginning of May 1941, and Bondi and Gold several months later.

5.2.2 SPSL's efforts to get OB released from internment.

From the summer of 1940 onwards, the SPSL was actively involved in appealing to the Home Office for the release of interned academics who were registered with them. Our knowledge of their correspondence with OB starts with MS S.P.S.L. 474/3 fol 356, which is not dated, but obviously stems from July 1940: it contains answers to some questions, apparently written by OB under difficult conditions: *'Research can be carried out wherever postal communication with some university and library is possi-*

ble.' - 'Research carried out at the moment concerns the problem of airscrew noise and was suggested by the Aircraft Establishment, Farnborough. Applicant would like to get permission for speedy correspondence with Mr H.B. Squire of Farnborough and opportunity to publish papers which are being completed at the moment'. It seems that this permission and opportunity were not given.

In Aug 1940, Prof Blackett wrote a confidential and personal letter to Ms Simpson, praising his mathematical abilities and his character and personality. *'I consider Bünemann a most valuable man in the eventualities that we all hope will occur. He is Aryan or whatever is the official title for a non-non-Aryan, and is definitely a political refugee.' ... 'In general he is I think one of the ablest & sanest political refugees I have met'.* But he also wrote: *'Prof. D.R. Hartree of Manchester could tell you more than I can about his mathematical work. I know he has been doing some applied mathematics connected to aeronautics, in collaboration with Dr Squire, now at the Royal Aircraft Establishment, Farnborough. I could collect details of all this for you if you would think it worth while.' ... 'As to possible employment, I would have to consult Hartree.'* [spsl-ob, fol 357]. Thus Ms Simpson wrote to Prof Hartree for more information from Mr. Squire: *'what interests the Home Office is his scientific value (which the Royal Society tribunal will assess) and his personal integrity and loyalty, for which you,'* [Prof Blackett] *'and perhaps Professor Hartree also, vouch.'* She also wrote 'I shall certainly prepare an application for his release' [spsl-ob, fol 358], but since neither Prof Hartree nor Prof Blackett (after having consulted Prof Hartree and/or Mr Squire) gave any statement about OB's scientific merit, this did not lead to OB's release. It may have helped though to speed up his transport back to England while some others remained interned in Canada until 1943 [VMC]. He arrived in Liverpool in January 1941, at the same time as Fuchs, Kellermann, Weiss and Perutz. Those were officially released during their stay in Canada in the fall of 1940, but had to wait for a transport back to England.

Back in England, OB was very disappointed to stay interned while many of his companions were released, mostly thanks to the help of SPSL. When he complained about this in a very polite letter to Ms Simpson, she answered with a warm, understanding letter and tried to get what she needed: *a detailed statement from an authoritative British scientist - preferably more than one - concerning your scientific work, together with assurances of your personal integrity and loyalty to this country.* (fols 361, 362). OB provided further information on his scientific work. Most of it was unpublished because of internment. He also provided the addresses of Mr Ison, Leonard Behrens and Arnold Watson and informed about his political activities before internment. (fols 366, 367). Ms Simpson wrote to all three of them, as well as Profs Hartree, Blackett and Mordell and tried to contact Mr Squire.

Prof Hartree answered this time [spsl-ob, fols 369-70, 27 Jan 1941]. He praised OB's scientific abilities as already cited in section 4.2. But his answers were not very positive with respect to any of the three central questions:
(Q1) what about his scientific value for the war efforts?
'He has, as far as I know, no definite work with which to continue. The work on airscrew noise was completed for his thesis, unless there are further developments of which I am not aware, and in any case I do not think there are any University funds available to

continue to support him here in research work on these lines.' [...] 'the difficulty is that at present almost all such work is going on in Government research establishments, for which an alien would not be acceptable.'
(Q2) what about naturalisation?
'As far as I know he has not applied for natualisation'.
(Q3) what about his personal integrity and loyalty to this country?
'I am aware of the difficulty of being certain of the motives of enemy subjects, and particularly of those who left Germany, as he did, ostensibly for political rather than racial reasons. But to the best of my knowledge and belief I regard him as personally reliable and loyal to this country. He has often been at my house,' [...] 'and I have never heard anything, either myself or from anyone else, which suggests the contrary. I also know of things he has done here' [...] 'which seems to me evidence of a real desire to help the ideals for which this country is fighting.
I do not, of course, know whether his views have been affected by the experiences of the last 6 months. Some experiences of which one has read or heard might seem enough to put rather a strain on previous loyalties to this country, though I wouldn't expect him to be so affected. But on account of this uncertainty I feel a difficulty about giving a quite unqualified assurance as required.' [spsl-ob, fols 369-70].

An answer from Mr Squire would have been very helpful for question (Q1). It seems that he was the only (other) person who knew the *'further developments of which I' [Hartree] 'am not aware'*, and who probably had obtained OB's letters and at least one of OB's manuscripts [Bun40, spsl-ob] for joint papers. But in spite of all the attempts to contact him, Squire never replied. [8]

Hartree's answers to (Q2) and (Q3) are in strong contrast to the answers of all others (Behrens, Ison, Mordell, Watson): they all answered something like *'I have an idea that he had applied or was applying for naturalisation'* (Mordell, fol 371); *'it gave him the greatest pleasure to be taken for a Britisher' [...] 'he was watching the date when an application could be lodged and I know that he ardently wishes to get his naturalisation'* (A. Watson, fol 374). All of them except Hartree were sure about his loyalty and integrity. Even Ms Simpson remarked in her answers to Mordell (fol 372) and Hartree (fol 373) that *'the whole business of naturalisation is suspended for the period of the war'* and that by her experience the loyalty of the released internees from Canada was not affected, but that they were even more motivated of doing everything possible tohelp this country to win the war. And she added *'We are now going ahead with an appeal for his release from internment, and we hope that he will soon be free'* [spsl-ob, fol 373, 30th Jan 1941]. This appeal needed some time to be passed on to the Home Office by the Royal Society with their recommendation - how fast was a question of the frequency of the meetings of their special tribunal.

[8] We may find a clue to Mr Squire's reticence in the Biographical Memoirs of Fellows of the Royal Society [GY62], according to which he had 'something of the iron of the self-reliant nonconformist'. As a professor at Imperial College later on, he *'was always approachable - up to a point. When he had had enough of a conversation he would unobtrusively cease to listen.'* Squire's research on rotary-winged aircraft (and thus on airscrews) was not considered important for the war at Farnborough. It was delayed to later years.

5.2.3 OB's release from internment

A new set of letters was started by Mr Behrens (fol 379, 19th Feb 41). These letters now focussed on the question of employment, on the fact that OB did not have a job to which he could have been released, and that he was not allowed by the camp authorities to apply for a job.

Before this question was resolved, the Letter from the Home Office arrived that he was to be released (fol 386). It is dated 22nd April, 1941. OB's letter to Ms Simpson that he just has been released is dated 5th May, 1941. He expressed his sincere gratitude to her for the way in which she had effected it: *'I not only appreciate the fact that you have collected all the material and launched the actual application, but also that you have done so with a promptness and speed which was so reassuring after the grave difficulties which we had to overcome in all official matters.*

In the various camps I have met nothing but praise for the Society's work, efficiency and sympathy. The many delays with which our applications were confronted, we were sure, were never due to the Society. We were under the impression that the energetic and buisinesslike manner in which the Society pushed the applications compensated for the many stoppages in the proverbial "bottle-necks".

Allow me to conclude by offering you my humble thanks for the freedom which I owe to you and the fact that I can now do my small part for the British cause.' [spsl-ob, fol 387].

We authors of this study fully agree. It is impressive to see how deeply Ms Simpson identified with OB's case - as if it was the only case she had to take care of. But in reality she took care of many different cases at the same time, and the SPSL archives are awash with copies of her letters to the Society's beneficiaries, each with her characteristically warm and personal touch [SPSL], [spsl-ob, fol 388].

6 Conclusions

Around the time when OB was released, regulations about military research by friendly enemy aliens were changed. Thus OB could join *'Hartree's magnetron group'*, one of the British groups developing Radar for the Ministry of Supply (compare section 2). During this time Hartree, OB, Phyllis Lockett (later Nicolson) and David Copley closely cooperated. At a history meeting many years later, Buneman described this in modern language: Hartree wrote a 'computer program' (with loops and goto statements), and the other three acted as human CPUs (sometimes in parallel), doing their computations on mechanical desk calculators and keeping track of the positions of the particles on a plastic sheet. During this time a close friendship between Hartree and OB arose which persisted as long as Hartree was alive.

The profound influence of this time on OB's later work was already outlined in section 2: though there were times in his later life during which he was busy with other scientific work, he was the only one who carried on with extending and further developing the numerical methods of Hartree's magnetron group, and thus he became the founder of the particle methods and a pioneer in visualisation of numerical results.

From comparison with the historical development of other numerical methods[9], we certainly cannot say that particle methods would not exist today without the political circumstances which led OB to become a member of Hartree's group, but probably the development of the method would have been less straightforward otherwise.

There was a strong political impact on the lives of all persons who emigrated because of the Nazis. Nevertheless we may say that OB's life was influenced more strongly by politics than the lives of many others.
Without WWI, he probably would have grown up in Italy. Would he have decided to study mathematics and physics there as well?
While studying in Hamburg, Buneman enjoyed doing pure mathematics, algebra, in close contact with Emil Artin. Had he stayed in Hamburg, he probably would have stayed in that field, and he probably would have become a school teacher for mathematics and physics later on.
Also, his time in the Hamburg prisons apparently had consequences for his behaviour while interned, and for the length of his internment by the British. In Hamburg, Artin sent him mathematical problems in order to distract him from ruminating his plight as a prisoner. Thus he wrote papers during his British internment - but they aroused the suspicion of the guards and were taken away by the police. They are thus lost. Klaus Fuchs, however, wrote several papers right after his return to Edinburgh, not during internment.

The length of internment was clearly dependent on the scientific experience and reputation of the immigrant: The well-known scientists Max Born (1882 - 1970; Nobel Prize in 1954), Michael Polanyi (1891 - 1976) and Rudolf Peierls (1907 - 1995), for instance, were not interned at all. The Italian mathematician Beniamino Segré (1903 - 1977) sent his own application (MS SPSL 285 1) for release from internment to the Home Office (HO) in July 1940. In addition the SPSL prepared an application on his behalf, with statements of support from several UK mathematicians. Later they passed that initiative on to the University of Cambridge. Segré, however, seems to have been released on the strength of his own direct application to the HO, before all the letters of support for the SPSL/Cambridge application on his behalf had been collected.

Without his time in prison, OB would have completed his PhD before his internment, as had done his companions of the 'camp university' of comparable age (Fuchs, Weiss, Perutz and Kellermann). They were released in January 1941. The considerably younger ones (Bondi and Gold), however, were released considerably later than OB.

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[9] see for instance the textbook [OR70] for many examples of numerical methods that were invented several times at different places and different times and given different names

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