The Innermost Kernel

Suzanne Gieser

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Depth Psychology and Quantum Physics. Wolfgang Pauli's Dialogue with C.G. Jung

With 29 Figures and 4 Tables

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To Lars-Göran, Sebastian and Daniel

Preface

To sum up, I should like to say that it seems that there must be very deep connections between soul and matter and, hence, between the physics and the psychology of the future, which are not yet conceptually expressed in modern science. [---] Such deep connections must surely exist, because otherwise the human mind would not be able to discover concepts which fit nature at all.

Pauli to Ralph König, 10 Mar. 1946.

In the autumn of 1986 I read Robert S. Westman's excellent essay *Nature, Art, and Psyche: Jung, Pauli, and the Kepler-Fludd Polemic.*[1] In it, he expresses surprise at the failure of anyone to ask why the physicist Wolfgang Pauli wrote a science-history essay couched in Jungian language. Why has nobody wondered what sort of terms Pauli was on with Jung? Later in the essay, Westman says that at first sight Jung's writings must appear enormously interesting and relevant to a historian of ideas and science.

I myself had been very interested in the new perspectives on man and on the nature of human knowledge that developed around the turn of the century and during the inter-war period. Around this time, our view of man was changed by the emerging depth psychology and our view of the world by modern physics. I found it particularly intriguing that there had been points of contact between these two disciplines. Many of the physicists who are regarded as pioneers of modern physics also took an interest at that time in epistemology and psychology. As I had had a particular interest in the psychology of C.G. Jung since 1981, Robert Westman's remarks gave me both encouragement and inspiration. Without more ado, I wrote to him asking whether he had any more information on the relationship between Pauli and Jung. He quickly replied, referring me to Armin Hermann and thus to the publication, just about to take place, of Pauli's collected scientific correspondence – and to the person chiefly responsible for it, Karl von Meyenn. Meyenn was at this time at the University of Barcelona and immediately invited me to visit and study the material.

[1] Robert S. Westman, 'Nature, Art, and Psyche: Jung, Pauli and the Kepler Fludd Polemic', *Occult and Scientific Mentalities in the Renaissance*, ed. Brian Vickers (London, 1984), 177 ff.

Without his help, support and encouragement, this work would never have been possible.

So in the autumn of 1987 I sat in a Jesuit monastery on the outskirts of Barcelona, reading Pauli's correspondence. Most of it concerned physics, but there were letters here and there which dealt with Pauli's philosophical interests. I felt a thrill of excitement at these letters. In one of them, Pauli related that he had written on a certain subject to Jung. My heart leapt: could there be a correspondence between Pauli and Jung? I wrote to C.G. Jung's estate and its then administrator, Dr Lorenz Jung, and in due course received the reply that such a correspondence had indeed been preserved and that it was filed in the archives of ETH (the Swiss Federal Institute of Technology) in Zürich. He gave me special permission to read these letters, which at the time were still medically confidential. In the summer of 1988, with the aid of a grant from the John and Johanna Håkansson Benevolent Fund, I was able to go to Zürich. Working among the ETH history of science collections at that time was Dr Beat Glaus. I cannot find the superlatives to do justice to the friendliness, helpfulness and enthusiasm he showed on my numerous visits to the archive. It was to no small extent due to his efforts that I was able to get in touch with Aniela Jaffé shortly before her death. She had been Jung's secretary for many years and – it turned out – had an extensive correspondence with Pauli. It became apparent that Pauli's correspondence on the subject of the psychology of C.G. Jung was very substantial. Also filed at the ETH was a correspondence between Pauli and Jung's colleague Marie-Louise von Franz, and at CERN in Geneva there were the letters exchanged between Pauli and his erstwhile assistant Markus Fierz, dealing largely with psychological and philosophical topics. On my visits to the CERN archive I have always received guidance from Dr Roswitha Rahmy. She has also been of great assistance in my investigations in Pauli's literary and scientific library, which is preserved in *La Salle Pauli*. I also wish to thank Markus Fierz, Res Jost, Marie-Louise von Franz, C.A. Meier and Franz Jung for taking the time to answer my questions concerning the relationship between Pauli and Jung.

It was now understood that I was going to write about the relationship between Pauli and Jung, with the letters as a starting point. But this was going to require me, as a confirmed humanist, to penetrate a little deeper into the world of physics. I was still vacillating nervously when Svante Lindqvist, at the Department of History of Science and Technology at KTH (the Royal Institute of Technology) in Stockholm, started to urge me on. His personality and his practical and moral support made the whole enterprise seem less daunting. Since my arrival at the Department of History of Science in Uppsala I have received support and encouragement from people too numerous all to be mentioned here. However I should like to give particularly heartfelt thanks to Professor Tore Frängsmyr, who shows real concern for his doctoral students and who has given me the benefit of his practical and factual knowledge throughout. In addition I should like to thank everybody at the Center for History of Science at the Royal Swedish Academy of Sciences, especially Christer Wijkström, who has always found the time to order books for me. I am indebted to the Niels Bohr Archive in Copenhagen for obliging help in connection with the correspondence of Niels Bohr. I am grateful for valuable discussions with Hans Primas and Ulrich Müller-Herold at ETH, Charles Enz at the University of Geneva and Lars Söderholm at KTH. For help with the English translation I wish to thank Bernard Vowles.

For the practical production of this book I should like also to thank the Hierta-Retzius Scholarship Fund and the Knut and Alice Wallenberg Foundation. The English translation has been produced with the aid of grants from the Swedish Council for Research in the Humanities and Social Sciences and the Anders Karitz Foundation.

Finally I should thank the most important person of all: my life companion Lars-Göran Eriksson, whose patience and wide range of knowledge, particularly concerning C.G. Jung, has made him an invaluable partner in discussion.

Stockholm in March 2004 *Suzanne Gieser*

Contents

List of Abbreviations

AHQP	Archive for the History of Quantum Physics. Office for History of Science and Technology, University of California, Berkeley
APHK	Niels Bohr, Atomic Physics and Human Knowledge (New York, 1958)
BSC	Niels Bohr's Scientific Correspondence
C.W.	Collected Works of C.G. Jung ed. Herbert Read, Michael Fordham, Gerhard Adler, William McGuire
Hist. Studies Phys. Sci.	Historical Studies in the Physical Sciences
PJB	Wolfgang Pauli und C.G. Jung: Ein Briefwechsel 1932–1958, ed. C.A. Meier (Berlin, 1992)
PJL	Atom and Archetype: The Pauli/Jung letters 1932–1958, ed. C.A. Meier (Princeton, 2001)
PLC	Wolfgang Pauli: Wissenschaftlicher Briefwechsel mit Bohr, Einstein, Heisenberg u. a. ed. Karl von Meyenn
Σ	Synchronicity
WHS	Wissenschaftshistorische Sammlungen der ETH-Bibliothek Zürich
WPP	Wolfgang Pauli: Writings on Physics and Philosophy (Charles Enz and Karl von Meyenn eds.) (Berlin, 1994)

Introduction to Wolfgang Pauli's Dialogue with C.G. Jung

Late in 1930, Wolfgang Pauli's world was falling apart. Only two years earlier the brilliant young genius had been appointed to the chair in theoretical physics at ETH, the Swiss Federal Institute of Technology, in Zürich. At that time he must have been one of the youngest professors in the world, only 28 years old. The year 1929 had been one of momentous change: he had taken the decision to leave the Catholic Church and in December the same year he had married the cabaret performer Käthe Deppner in Berlin. However any serenity on the surface was deceptive. As early as February 1930 he intimates to his Swedish friend and colleague Oskar Klein that all is not well with the marriage. He describes the matrimonial ties as very loose and gives him to understand that nobody would be less surprised than he himself if his wife were to leave the home.[2] In November the separation duly happened. She left him for a chemist whom she had already met before she married Pauli. Characteristically Pauli responded with sarcasm: 'If it had been a bullfighter I could have understood. But a common chemist...'[3] But despite the bantering tone, Pauli was devastated. The divorce marked the start of a profound crisis in his life. History records that it was in fact his father who recommended him to consult the man for whom Zürich was world-famous: the psychologist Carl Gustav Jung.

It is this encounter of the quantum physicist Wolfgang Pauli (1900–1958) and the depth psychologist C.G. Jung (1875–1961) that is the subject of this book. However it will deal with much more than merely the personal relationship between the help-seeking Pauli and the 'healer' Jung. For I wish to show that Pauli's interest in Jung's psychology cannot be seen as solely the consequence of his personal crisis. After 1934, when Pauli stopped undergoing analysis, he gradually developed a deepening philosophical interest in Jung's psychology as a method of contemplating the world and mankind. I also wish to show how in Jung's *Weltanschauung* he found perspectives which related to and developed the philosophical questions which had occupied him from the beginning of his intellectual life and in particular the problems which he had encountered in connection with the development of modern physics. The main question that I shall attempt to answer is: Why was Pauli interested in Jung's psychology and in what respect? What most people find remarkable is that a theoretical physicist, and one with a reputation for being extremely critical, could become interested in the ideas of the 'mystic' Jung. A descrip-

[2] Pauli to Klein, 10 Feb. 1930 [242], *PLC II*, 4. See also p. 7.

[3] Charles Enz, 'Rationales und Irrationales im Leben Wolfgang Paulis', *Der Pauli-Jung Dialog und seine Bedeutung für die moderne Wissenschaft*, eds. Harald Altmanspacher, Hans Primas & Eva Wertenschlag-Birkhäuser (Berlin, 1995), 24. Henceforth referred to as *Der Pauli-Jung Dialog*.

tion of Pauli's personality therefore becomes essential – an account that is both biographical and also focuses on his role in the evolution of quantum physics.

Pauli's early philosophical schooling, his critical epistemology and his close contact with his mentor Niels Bohr are all relevant to an understanding of Pauli's later interest in Jung's psychology and view of the world. At the same time this meeting of a representative of matter and a representative of the soul has also to be seen against the background of the development that had taken place in both physics and psychology in the late nineteenth and early twentieth century. It is moreover necessary to consider the meeting in the context of the peculiar intellectual atmosphere of Europe at the turn of the century and between the wars. Pauli's meeting and dialogue with C.G. Jung also represents a confrontation between two different intellectual temperaments – a confrontation that played a big part in the development and intensification of the philosophical outlooks of the two men.

I will mainly focus on a presentation of Pauli's own version of his philosophical background and interests. I think we must start here before we embark on a critical evaluation of his standpoint (which will not be included in this study). My contribution will be to place Pauli's self-image into a bigger historical-philosophical context. I will also tackle the question of whether there exists a direct link between Pauli 'the physicist' and Pauli 'the Jungian', or whether these two must be considered as two completely different beings arbitrarily brought together by the circumstances of Pauli's personal life. In my opinion this is a difficult question to answer, but I intend – without claiming to be exhaustive – to shed some light on it.

The Material

I should like to see my work as a part of the current research into the person and scientist Wolfgang Pauli, a research that is based on the continuing publication of the collected correspondence.[4] The publication of Pauli's scientific correspondence is a project that has been in progress since the 1970s. Pauli's widow Franca Pauli was very anxious to preserve the image of Wolfgang Pauli as that of the brilliant physicist, and nothing else. For this reason she did everything in her power to consign the 'Jungian' part of Pauli's thinking to oblivion.[5] She opposed any publication of letters dealing with such matters. Franca Pauli died in 1987 but the Pauli Committee still wanted to respect her wishes. But back in the early 1980s a Finnish professor of theoretical physics, K.V. Laurikainen, had studied the correspondence between Wolfgang Pauli and his colleague Markus Fierz that is deposited at CERN (The Pauli Archive). This correspondence ranges over many philosophical and psychological issues. In 1985 he published a book in Finnish based on the letters and in 1988 came *Beyond the Atom - The Philosophical Thought of Wolfgang Pauli*, published at Springer Verlag.[6] The fact that Laurikainen had not respected the conditions for having been allowed to read these letters and had published large excerpts from the letters without the permission of the Pauli Committee created some concern. This incident also put the question of the 'psychological' letters on the agenda. Censoring this part of Pauli's thinking would create immense problems: many letters would have to be cut apart so that they would no longer make any sense. According to Karl von Meyenn he had to struggle with the other members of the Pauli Committee for the inclusion of the psychological letters in the scientific edition of Pauli's correspondence.

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[4] *Wolfgang Pauli: Wissenschaftlicher Briefwechsel mit Bohr, Einstein, Heisenberg u.a.* ed. Karl von Meyenn (Berlin). Four volumes have so far been issued: Volume I covering the years 1919–1929 (Berlin, 1979); Volume II covering the years 1930–1939 (Berlin, 1985); Volume III covering the years 1940–1949 (Berlin, 1993); Volume IV, part 1 covering the years 1950–1952 (Berlin, 1996), part 2 the years 1953–1954 (Berlin, 1999), part 3 the years 1955–56 (Berlin, 2001). Part 4 will appear in two subparts, IV/4, i and IV/4, ii (Probably 2004) and one supplementary volume will also be forthcoming. (The volumes will henceforth be referred to as *PLC* (Pauli Letter Collection) *I*, *PLC II*, *PLC III*, *PLC IV/1, IV/2, IV/3, IV/4 i*, *PLC IV/4 ii* and *PLC suppl.*

[5] Karl von Meyenn told me that she burnt all the letters from Marie-Louise von Franz that were found in his office on the occasion of his death.

[6] The title of the Finnish version is *Atomien tuolla puolen: Wolfgang Paulin ajatuksia hengestä ja aineesta, todellisuuden luonteesta ja pahan asemasta* (Helsinki, Kirjapaja 1985).

The Committee and other experts finally yielded to the argument that 'it is of no importance what we think of Jung and his psychology. The important thing is that Pauli was a convinced adherent of Jung's teachings. One cannot therefore leave out this part of his writing and his estate.'[7] From Volume IV/1 covering the years 1950–1952 the psychological letters are included in the Pauli Letter Edition. Letters concerning psychological issues prior to that will appear in a supplementary volume.

My contribution to this may perhaps be said to lie in the fact that in 1988 I learned that the C.G. Jung estate contained preserved letters from Pauli, and later I discovered more letters exchanged by Pauli and members of the Jung circle. As far as I know I must have been one of the first researchers to be given special permission by the C.G. Jung estate to study the Jung-Pauli letters.[8] These have now been published by C.A. Meier, a colleague of Jung and a good friend of Pauli's, and translated into English.[9] I must also be one of the first 'outsiders' to have read the correspondence between Pauli and Jung's secretary Aniela Jaffé and Pauli's correspondence with Marie-Louise von Franz. The seeds of this book thus began to germinate with the discovery of Pauli's extensive and original collection of letters. It is these unique and exciting letters that form the greater part of my material. It is therefore natural for me to make Wolfgang Pauli and his interest in Jung's psychology the central theme of my study. The man and scientist Wolfgang Pauli is the lesser known of my two leading characters. Shelf-metres have been written about Jung, so I do not feel particularly compelled to undertake a fundamental analysis of Jung's scientific, philosophical and personal background. For that reason a comprehensive examination of all the angles from which C.G. Jung's psychology may be approached should not be expected. Here I shall only consider those aspects of Jung's thinking which were crucial to the exchange of ideas with Pauli.

In more recent literature there is agreement that Pauli's contribution as a colleague and a 'sounding board' was absolutely vital to the scientific discoveries that have been attributed to Heisenberg and Bohr.[10] Victor Weisskopf believes that there was not a single advance in the development of the quan-

[7] Karl von Meyenn to Suzanne Gieser, 16 August 2003, private possession.

[8] The Jung-Pauli letters were known to the Pauli Committee but they were 'not allowed' to mention them in connection with their edition of the Pauli letters. The letters were still subject to medical confidentiality. Meyenn to S. Gieser, 16 August 2003.

[9] *Atom and Archetype: The Pauli/Jung letters 1932–1958*, ed. C.A. Meier (Princeton, 2001). Henceforth abbreviated as *PJL*. The original letters are in Wissenschaftshistorische Sammlungen der ETH-Bibliotek Zürich, henceforth abbreviated as *WHS*. The English translation contains several errors, I have therefore taken the liberty of altering the translation when it deviates to much from the original.

[10] Hendry, *The Creation of Quantum Mechanics*, 130–31.

tum theory in which Pauli did not participate, despite the fact that he never asserted his authorship.[11] He has even been called the architect behind wave-particle complementarity.[12] Pauli is portrayed as a brilliant genius, indeed even as the greatest physicist of his time. His colleague Max Born compares him with Einstein and says that in certain respects he has to be considered even greater than Einstein.[13] Yet Pauli did not become so well known as many of his colleagues. This is to a large extent because he shunned the glare of publicity and preferred to exert influence through his letters. Compared with, for example, Bohr, Heisenberg or Schrödinger, he did not publish very much of either a scientific or a more popular character. More often he expressed his opinions in direct communication person-to-person. Where Pauli's scientific achievements are concerned, therefore, the publication of his collected correspondence is particularly important. He and his letters were regarded as an institution in themselves; the letters were pinned on the notice board or passed from hand to hand until they had been all round the department.[14] Pauli's excessively critical attitude led him to be extremely cautious in publishing, and his publications contain only a fraction of the work he actually did. It would therefore be entirely misleading to assess Pauli purely on the strength of his published works. When Paul Ehrenfest proposed Pauli as a candidate for the Lorentz Medal in 1931, he stressed in particular the importance of Pauli as a partner in discussion and as a letter-writer.[15]

The preserved correspondence between Pauli and Jung extends from 1932 until 1957 and consists of 73 letters (including 2 letters from Pauli to Jung's wife Emma). The most intensive periods of writing were in 1950 and 1953, years in which they exchanged nine letters with each other. This more concentrated period of correspondence coincided with their joint publication.[16] The letters from 1950 deal largely with Jung's concept of synchronicity and Pauli's Kepler essay, while those from 1953 are concerned with the more fundamental questions concerning the relationship between psychology and physics and between science and religion, and the possibility of a unified worldview. It is difficult to imagine the quality of the personal relationship between Pauli

[11] Weisskopf, 'Vorwort', *PLC I*, V-VI.

[12] Mara Beller, *Quantum Dialogue: The Making of a Revolution* (Chicago, 1999), 142.

[13] Hendry, *The Creation of Quantum Mechanics*, 130; Max Born, *The Born-Einstein Letters from 1916–1955* (London, 1971), 228.

[14] Oskar Klein, 'Wolfgang Pauli: Några minnesord', *Kosmos* (1959), 9. See also Heisenberg to Pauli, 28 Oct. 1926 [144], *PLC I*, 349.

[15] Ehrenfest to Pauli, 25 Mar. 1931 [271], *PLC II*, 72.

[16] Wolfgang Pauli & C.G. Jung, *Naturerklärung und Psyche* (Zürich, 1952), which contains Jung's contribution *Synchronizität als ein Prinzip akausaler Zusammenhänge* and Pauli's essay *Der Einfluß archetypischer Vorstellungen auf die Bildung naturwissenschaftlicher Theorien bei Kepler*.

and Jung. The letters bear witness to mutual respect and sympathy. On a few isolated occasions Pauli visited Jung privately, either in his villa at Küsnacht or in his retreat at Bollingen, but it was never a question of close friendship.

I shall not base my account on the contents of the correspondence between Pauli and Jung alone. Pauli's voluminous correspondence with Jung's secretary Aniela Jaffé (116 letters) has in fact to be regarded as to some extent addressed to Jung himself. Jaffé relates that she acted as a go-between for Pauli and Jung – a role that she was happy to play.[17] Apparently Pauli also used this strategy of reaching 'the master' indirectly, through intermediaries, with other scientific colleagues whom he respected.[18] These letters are extremely informative concerning Pauli's attitude to Jung's psychology and ideas, but they also contain more personal communications between Jaffé and Pauli.[19] I have also consulted Pauli's correspondence with his former assistant, the physicist Markus Fierz, and with Jung's colleague Marie-Louise von Franz. The core material in my work consists therefore primarily of some 400 letters which concern Pauli's interest in Jung's psychology. In addition to these specifically 'psychological' letters I have examined the remainder of the still unpublished correspondence included in *The Pauli Letter Collection (PLC)*, which is collected in the CERN archive, as well as the letters already published in the PLC series.[20]

For a while, Pauli seems to have been very close to Marie-Louise von Franz. They got to know each other in 1947 while Pauli was working on his essay on Johannes Kepler. Von Franz was one of the few in the circle surrounding Jung who knew Latin well enough to be able to help Jung and others with the translation of Latin texts. She also helped Pauli with the translation of Kepler and Fludd. Unfortunately only Pauli's letters to von Franz have been preserved (except for one), von Franz' letters to Pauli were burned by Pauli's widow when she discovered them in a box in his room at ETH,the institute of technology in Zürich. It has been implied that they had a sexual relationship, but this is firmly denied by von Franz.[21] Relations between them were problematic and seem to have terminated in the autumn of

[17] Jaffé to Beat Glaus, 20 Aug. 1988, private possession.

[18] See *PLC IV/2I*, XIV.

[19] The correspondence between Pauli and Marie-Louise von Franz, and between Pauli and Aniela Jaffé, is in the ETH archive for history of science collections *WHS*, while the correspondence between Pauli and Markus Fierz is included in *PLC* at CERN.

[20] Since I wrote my original thesis in 1995 many more letters have come to light that are relevant to the issues I discuss below. Letters to C.A. Meier, Erwin Panofsky and Franz Kröner are among the more important. I have consulted these in this revised version of my thesis.

[21] See Herbert van Erkelens, 'Wolfgang Pauli's Dialogue with the Spirit of Matter', *Psychological Perspectives* 24 (1991).

Pauli in his most usual position: writing letters[24]

1955. Marie-Louise von Franz states that Pauli always kept his various interests and relationships in watertight compartments and that she had no idea that Pauli had corresponded with Jung and Jaffé. One forms an entirely different impression of their relationship from a reading of Pauli's letters, where he appears very open and communicative. Pauli refers to several discussions he has had in his correspondence with Jung. Sometimes he quotes long passages and in one case he even encloses a copy of his letter to Jung and asks for her comments on it.[22] As always in the recollection of history there is more than one version and more research is needed for us to obtain a fair picture of this relationship.[23] (More below).

A certain amount has been written about Pauli's epistolary art.[25] He wrote in a sophisticated and beautiful German.[26] He became so known for his

[22]See, for example, Pauli to von Franz, 13 Jan. 1952 [1341], *PLC IV/1*; 12 Oct. 1952 [1472], ibid; 30 Oct. 1952 [1492], ibid; 1 Apr. 1953 [1545], *PLC IV/2*; 6 May 1953[1569], ibid; 15 May 1953[1572], ibid; 11 Jul. 1953[1598], ibid; 30 Oct. 1953[1667], ibid; 6 Nov. 1953 [1669], ibid; 12 Nov. 1953 [1672], ibid; 25 Nov. 1953 [1677], ibid; 27 Oct. 1955 [2173], *PLC IV/2*.

[23]Von Franz has referred to Pauli in several places in her writings. See for example Marie-Louise von Franz. *Number and Time* (London, 1974); idem, *C.G. Jung: His Myth in Our Time* (New York, 1975); idem, *Dreams* (Boston, 1991), 171–172, footnote 104, 106; idem, *Psyche und Materie* (Einsiedeln, 1988).

[24]Wolfgang Pauli during a trip on lake Geneva 1958, Photo No. PAULI-ARCHIVE-PHO-146, courtesy *CERN-archive*, Geneva.

[25]Karl von Meyenn, 'Paulis Briefe als Wegbereiter wissenschaftlicher Ideen', *Wolfgang Pauli: Das Gewissen der Physik*, eds. Charles Enz & Karl von Meyenn (Braunschweig, 1988), 20 ff.

[26]Charles Enz, 'The History of This Translation: Paul Rosbaud, Friend and Publisher of Wolfgang

particular style that his colleagues coined the expression (in English) 'Pauli style'. When in later years he regained his youthful enthusiasm with regard to any particular subject it was said that someone had received a letter in the 'old Pauli style'.[27] Pauli wrote almost all his letters by hand. This says something about his attitude to letter writing as an activity. Walter Elsasser apologized on one occasion to Pauli for using English in order to be able to dictate his letter to his secretary. Pauli was not slow to comment: 'in my case I don't like dictating whatever the language, but I'll gladly write by hand in any language'.[28] To Pauli letter-writing was not reporting or social activity but largely a *creative act*. It is no exaggeration to say that his mental activity depended on his addressing himself to another person. Armin Hermann describes him as being unusually 'dialogue-minded'.[29] Pauli himself said that his ability to concentrate and to clarify his thoughts needed him to be allowed to express himself in writing.[30] For that reason his letters could sometimes take the form of long treatises of up to 130 pages. He was often seen bent over a sheet of paper with a pen in his hand, whether he was in his room at ETH, at home, or in the bar or the cafe after a Sunday walk in the mountains. This explains why Pauli has left one of the largest collections of letters of our time and also why there are letters between him and Jung, Jaffé and von Franz, people who lived close by and whom he met on regular basis.

Basically Pauli saw his letters as public documents intended for distribution to anyone who might be interested in their contents. If a letter was private or confidential he always pointed this out. He himself treated letters he had received in the same manner; if he thought their contents could be of interest in a particular context he enclosed them with his own letter to the recipient. Where letters to Jung or to people in Jung's circle were concerned it was largely this procedure that he followed. He particularly discussed his correspondence with Jung and its contents with Fierz, Jaffé, and von Franz. Naturally this does not mean that Pauli regarded his correspondence with Jung as public property, but nor did he treat it as strictly private. He saw the letters as *a basis for discussion*, in which he could allow himself to speculate and wonder freely,

Pauli', Wolfgang Pauli, *Writings on Physics and Philosophy*, 1.

27 Meyenn, 'Paulis Briefe als Wegbereiter', 22 ff.

28 Pauli to Elsasser, 30 Sep. 1958 [3067], *PLC IV/4ii*.

29 Hermann, 'Die Funktion und Bedeutung von Briefen', XXV. There are also those who feel that Pauli's 'dialogue' was more like a monologue – in other words that he did not allow the other person to get a word in edgeways, particularly in personal conversation. Cf Hermann Levin Goldschmidt, 'Begegnung mit Wolfgang Pauli', *Nochmals DIALOGIK* (Zürich, 1990), Stiftung Dialogik beim Archiv für Zeitgeschichte der ETH Zürich, 61.

30 Pauli to von Franz, 19 Sep. 1951 [1281], *PLC IV/1*; Pauli to Carnap, 22 March 1954 [1746], *PLC IV/2*. See also Pauli to Fierz, 7 Jan. 1948 [929], *PLC III*, 495.

without needing to worry about having to defend every word. This must not be forgotten when studying Pauli's correspondence. There is much to indicate that Pauli drew a relatively sharp line between what he discussed with the Jung circle and what he discussed with his fellow-physicists. Yet at the same time we know that he was always looking for discussion partners outside Jung's circle with whom he could discuss 'Jungian' perspectives. On the other hand there were colleagues from whom he wished to keep his interest in Jung entirely secret. It appears however that even on that front he became increasingly open as he got older. But it must not be forgotten that many people had no idea that Pauli was anything more than an unusually critical and intelligent physicist.

It is not altogether easy to reconstruct Pauli's opinions on Jung's psychology from the letters. Although Pauli's correspondence is massive and full of material it is nevertheless difficult to follow all the reasoning and discussions. Argumentation which begins in a letter, may have been concluded in a verbal discussion, to which of course I have not had access. Sometimes there are inconsistencies and contradictions, depending on whom Pauli is addressing. One does not always know which of the opinions is nearest to Pauli's real point of view. In addition it is always necessary to bear in mind the time scale: the letters extend from 1932 to 1958, i.e. over a period of 26 years. During this time Pauli's view of Jung's psychology naturally developed and changed. An important part of my analysis consists in trying to establish in what manner this happened and what Pauli's final position on Jung's ideas was. This is naturally not easy, and has to be seen as a first tentative attempt to establish Pauli's attitude to Jung's psychology.

Wolfgang Pauli, the Copenhagen School and Philosophy

Biographical Sketch

Wolfgang Ernst Friedrich Pauli was born in Vienna on 25 April 1900. His father, born Wolfgang Joseph Pascheles, was a professor of chemical medicine and came from a respected Jewish family in Prague. Pauli's grandfather, Jacob W. Pascheles, had inherited a bookshop that he managed so well that he could afford to buy a house in the Old Town Square in Prague. As a respected member of the Jewish congregation and rabbi of Prague's celebrated Gypsy Synagogue he presided at the bar mitzvah of Franz Kafka, whose family also lived in the Square. Pauli's father attended the same school as Kafka (although not at the same time). Pauli's father went on to study medicine at the Carl-Ferdinand University in Prague together with Ludwig Mach. Ludwig was the son of Ernst Mach, by this time a very well known scientist and theoretician and professor of experimental physics at the same university. Ernst Mach became both teacher and fatherly friend to Pauli's father and later also had a great influence on Pauli. In 1892 Pauli's father moved to Vienna. Like many other secularized Jews he changed his surname to a less Jewish-sounding one, taking the name Pauli and converting to Catholicism. He did this solely to escape growing anti-Semitism and to pursue a university career. Pauli's father made an academic career at the University of Vienna, where he became a professor and later the director of a new institute of medical colloid chemistry. In 1895 Ernst Mach also came to the University in Vienna, where he was installed in a new chair in philosophy, specializing in history and the theory of the inductive sciences. Ernst Mach was asked to be godfather to Wolfgang Pauli, who thus acquired Ernst as his second name.[31]

Bertha Camilla Schütz was the name of Pauli's mother, but she was called Maria. She was an intellectual woman, had an extensive knowledge of dramatic literature, and was a socialist and a feminist. She is described as one of the few true intellectuals among Austrian women. The interest in drama and literature came from her father, Friedrich Schütz. He, too, was of Jewish descent and born in Prague. He was a writer, playwright and journalist. He was on the staff of the radical newspaper *Neue Freie Presse*,where later his daughter also worked. Pauli's mother was one of very few women who went

[31] Enz, *No Time to be Brief*, 1 ff.

to high school. She passed her exams at the age of 27, when Pauli was 5 years old. She worked as a writer and journalist. She wrote a book on the French Revolution and essays on Marie Antoinette and Lady Byron. In 1911 the Paulis left the Catholic Church to be baptized as evangelists. There is no known reason for this as they seemed to have lived a secular life. Still Pauli speaks of an inner conflict between Protestantism and Catholicism over a period of 10 years, dealt with in his dreams.[32] Pauli further describes his Jewish roots as *repressed* in the first half of his life (until 1928), which leads to the suspicion that religion must have been a problematic issue in the family.[33] From both parents Pauli learned to adopt a critical attitude, maybe overcritical: 'obedience to authority was not sung to me in the cradle' he wrote to his colleague Abraham Pais.[34] In 1906 Pauli's sister Hertha Ernestina (another reference to Ernst Mach!) was born. This came as a great shock to Pauli, who felt jealous and rejected when suddenly the baby Hertha became the object of his beloved mother's and grandmother's devotion. Pauli describes this event as 'the birth of his anima' (the female side of his personality).[35] Hertha became an actress and was called to the famous German Theatre in Berlin by Max Reinhardt. She collaborated on film and radio projects. On the rise of the Nazis she first returned to Vienna, where she wrote several books, before fleeing to Paris, where she was involved in the resistance. Finally she ended up in America, where she married and acquired the surname Ashton. In her semi-documentary short story *Break of Time* she describes the persecution of political activists in Vienna and her flight to America after the German *Anschluß*.[36] Like her brother, she died childless.

In 1918 Pauli matriculated from the *gymnasium* in Döbling (a district of Vienna). Pauli's class has gone down in local history as the 'class of geniuses'. Among the 27 boys there were two future Nobel prizewinners, two famous actors, three university professors, two directors of medical schools, one politician and so on. Pauli was the only one in his class who did not join the army for the First World War, he was exempt because of 'cardiac insufficiency'. When still only 18 Pauli had a sufficient knowledge of mathematics and physics to write three essays on the general theory of relativity that attracted the attention of the mathematician Herman Weyl.[37] Pauli decided

[32] Pauli to Aniela Jaffé, 10 Apr. 1952 [1396], *PLC IV/1*.
[33] Pauli to von Franz, 6 November 1953 [appendix to 1669], *PLC IV/2*.
[34] Pauli to Pais, 17 Aug. 1950 [1147], *PLC IV/1*.
[35] Pauli to Jung, 28 Feb. 1936 [16P], *PJL*.
[36] Hertha Pauli, *Der Riß der Zeit geht durch mein Herz. Ein Erlebnisbuch* (Wien und Hamburg, 1970). English title *Break of Time*. Enz, *No Time to be Brief*, 12 ff.
[37] Weyl to Pauli, 10 May 1919 [1], *PLC I*, 3.

to go to Munich, to study theoretical physics under the guidance of Arnold Sommerfeld. Sommerfeld wrote to his Austrian colleague Josef von Geitler:

> I have around me a really astonishing specimen of the intellectual elite of Vienna in the young Pauli… a freshman! His talent is many times greater even than that of Debye[38]

On Pauli's death Lise Meitner, physicist and a colleague of Pauli, sends a letter of condolence to his wife. She writes:

> I have very often recalled and also related that I met Sommerfeld in Lund in the autumn of 1921 and that he told me that he had a student so gifted that he could learn nothing more from Sommerfeld, but because of the German university regulations had to sit off 6 terms before he could get his doctorate. So he (Sommerfeld) had set this student to write an article for an encyclopaedia. When I asked his name Sommerfeld mentioned the name Wolfgang Pauli, with which I was already acquainted.[39]

Pauli's Swedish colleague, the physicist Oskar Klein, has summarized Pauli's personal development as a journey from Mephistopheles to Buddha.[40] The young Pauli earned the epithet Mephistopheles for his keen critical and analytical ability. This ability had two sides: on the one hand it expressed itself in an amazing facility for quickly finding the flaw in complicated mathematical and logical reasoning; on the other hand it could be expressed in his not always equally appreciated sharp tongue and sarcastic humour. His basic attitude was sceptical. He was therefore a natural choice for the role of Mephistopheles, 'the spirit that denies', when a physicists' pastiche of Goethe's *Faust* was produced at the Bohr Institute.[41] But as Pauli could not be present on that occasion Léon Rosenfeld played his part.

Pauli remained inclined to sarcasm all his life, but gradually his personality became more rounded and Buddha-like. Pauli acquired his Buddha epithet not only for his expanded wisdom but also for his growing physical bulk. He is described as of small stature, stocky with a straight, neat nose, his head constantly vibrating as if always nodding.[42]

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[38] Sommerfeld to von Geitler, 14 Jan. 1919, see Karl von Meyenn, 'Einleitung', Wolfgang Pauli, *Physik und Erkenntnistheorie*, (Braunschweig, 1984), X.

[39] Lise Meitner to Franca Pauli, 22 Jun. 1959, *PLC*, unpublished (will appear in *PLC suppl.*). See also *PLC III*, 125.

[40] Klein, 'Wolfgang Pauli: Några minnesord', *Kosmos* (1959), 11.

[41] Emilio Segré, *From X-Rays to Quarks* (Berkeley, 1980), 155; 'Die Faustparodie', *Niels-Bohr 1885–1962: Der Kopenhagener Geist in der Physik*, eds. Karl von Meyenn, Roman U. Sexl & Klaus Stolzenburg (Wiesbaden, 1985), 308 ff. For a very picturesque description of the personalities of both Pauli and Bohr, see the dialogue between 'the Lord' (representing Bohr) and 'Mephistopheles', ibid., 319–320.

[42] Kurt Guggenheim, *Gerufen und nicht gerufen* (Zürich, 1973), 68. In his novel Guggenheim describes Pauli and his wife Franca as Paul and Jolanda Mende.

Pauli as Mephistopheles in the Faustian pastiche that was put on during the physicists' conference of 3–13 April 1932.[43]

Pauli has often been compared with his contemporary colleague Werner Heisenberg. They seem to have been a pair with an almost telepathic understanding and are regarded, together with Bohr, as the driving force behind the development of the Copenhagen school of physics.[44] At the same time the difference between Pauli and Heisenberg is described as like that between night and day. Pauli loved being out at night, talking and drinking, and by the time he at last got up the next day Sommerfeld's lectures had usually finished. Heisenberg on the other hand was up with the lark, worked hard and loved walking in the mountains or sitting under a tree reading Plato. Heisenberg was very interested in philosophy and had a strong creative scientific intuition, whereas Pauli comes over as an iconoclast who never allowed himself to be content with an idea but always used his scientific acuity to query and criticize. Pauli was an urban man, whereas Heisenberg loved nature.[45] But whatever the differences in temperament, they became good friends and Heisenberg has said in his memoirs that his discussions with Pauli were the greatest single influence on his work.[46] Heisenberg gives a snapshot of this difference in temperament:

> An hour or two after the end of Sommerfeld's lecture, Wolfgang would appear in the seminar, and our conversation would go something like this:
>
> Wolfgang: 'Good morning. If it isn't our prophet of nature! You look for all the world as if you have been living by the principles of St. Jean-Jacques. Wasn't it he who said, ›Back to nature, up into the trees, you apes‹?'

[43] 'Die Faustparodie', *Niels-Bohr 1885–1962: Der Kopenhagener Geist in der Physik*, 317. Courtesy *Niels Bohr Archive*, Copenhagen.

[44] This is of course an oversimplification, but this is how it is often presented. People like Max Born, Pascual Jordan, and Hendrik Kramers, to mention only a few, made major contributions.

[45] Segré, 153–55.

[46] Werner Heisenberg, *Physics and Beyond: Encounters and Conversations* (London, 1971), 27.

Pauli as Buddha.
'I would like to see Tom Kelder's sketch of me. (The sculptor Haller in Zürich has made a bust which makes me look rather introspective – i. e. Buddha-like.)'[47]

> 'The second part of the quotation is not from Rousseau,' I would explain, 'and none of us goes in for climbing trees. In any case, it isn't morning; it's twelve o'clock, if my watch is correct. One day you simply must introduce me to one of your nightly haunts so that I, too, can get a whiff of your physical inspiration.'[48]

Pauli's particular brand of humour has given rise to a large number of anecdotes. Here I shall just mention one, which I feel, is appropriate to our topic. During one Solvay Congress, Pauli, Heisenberg and Dirac were sitting in the foyer of the hotel discussing religion. The discussion was largely between Heisenberg and Dirac, whereas Pauli was silent. Heisenberg believed that religion has to be understood as man's need for something transcendental and mystical, whereas Dirac argued that religion is the opium of the people. When Heisenberg asked Pauli for his views on the matter Pauli had only one comment: 'Now I understand. There is no God, and Dirac is his prophet.'[49]

At the age of 21 Pauli made his name known with an article on the theory of relativity that he wrote at the request of Sommerfeld. This article was so well written that it earned the admiration of Einstein himself. Moreover it has, apart from a few minor adjustments, remained relevant to this day.[50]

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[47] Pauli to Ralph Kronig, 22 Dec. 1949. Illustration and quotation from Wolfgang Pauli, *Writings on Physics and Philosophy*, 27. The bust of Haller is in 'La Salle Pauli', CERN. Cf. [1067], *PLC III*, 725. Courtesy *CERN-archive,* Geneva.

[48] Ibid., 28.

[49] Valentine L. Telegdi, 'Pauli-Anekdoten', *Wolfgang Pauli: Das Gewissen der Physik*, 119.

[50] Wolfgang Pauli, 'Relativitätstheorie' (1921), ibid., 123–147.

Einstein wrote a brief review of Pauli's article:

> One does not know what to admire most, the psychological grasp of the development of the ideas, the assurance of the mathematical deduction, the deep physical insight, the capacity for lucid and systematic presentation, the knowledge of the literature, the technical integrity, the confidence of the criticism.[51]

In the year in which Pauli published his article on relativity he also completed his education under Sommerfeld. He followed this by working for a year with Max Born in Göttingen. However Born's approach to physics was too formally mathematical for Pauli's taste. He moved to Hamburg to work for a while as assistant to Wilhelm Lenz. Bohr, who first met Pauli at the 'Bohr-Festspiele' in Göttingen (1922), invited him to come to Copenhagen and work as his assistant during the academic year 1922–23. In 1924 Heisenberg, too, came to Copenhagen, and together they may be said to have been at the heart of the process that is today known as the Copenhagen school s interpretation of quantum physics. In 1924 Pauli obtained a docentship in Hamburg and in the same year he formulated the exclusion principle for which he was to be awarded the Nobel Prize in 1945.[52] The trail-blazing feature of the exclusion principle was Pauli's discovery that the three quantum numbers for energy, angular momentum and its component along the quantizing axis are not enough to establish the state of the electron in the atom. A fourth value is needed, which had previously been assigned to the atomic nucleus and which fixes the 'peculiar ambiguity, incapable of classical description' of the electron. What Pauli describes in such hesitant terms is the spin of the electron, which he himself long found hard to accept. The Pauli exclusion principle is of fundamental importance and is today one of the basic principles of physics. It means that two different electrons in one and the same atom can never have identical values for the four quantum numbers, n, l, m_l and m_s, which characterize the state of the electron. The consequence of this is that the electrons form shells around the atomic nucleus. This scale model of the atom explains not only the periodic system but also the stability of matter.

During the period 1924–27 Pauli remained in close touch with Copenhagen. In 1928 he was appointed professor of theoretical physics at ETH, the Federal Institute of Technology, in Zürich. During this period Pauli did a great deal of work on the quantum field theory, of which he is one of the creators. He also took a lot of interest in beta decay, which led him in 1930 to suspect the existence of a new particle, the neutrino, which was not verified

[51] Albert Einstein, 'Besprechungen – Pauli, W. jun., Relativitätstheorie', *Die Naturwissenschaften* 10 (1922), 184–185. Quoted in *Wolfgang Pauli: Das Gewissen der Physik*, 123.

[52] He was first proposed for the Nobel Prize in 1933 by the Swedish physicist C.W. Oseen.

by experiment until 1956. He was later to call this discovery 'the foolish child of my crisis'.[53]

A number of factors combined to bring about Pauli's crisis in 1930. In 1927 Pauli's mother took her own life after his father had left her and married a younger woman, whom Pauli detested.[54] Upon this followed his unhappy marriage in 1929 and his divorce in 1930. Pauli fell into a deep depression and began to drink more than before. It was presumably Pauli's father who recommended him to seek psychological help and proposed C.G. Jung, who was well known in Zürich.[55] In 1931 Pauli and Jung met for the first time and in February 1932 Pauli began his analysis with a pupil of Jung.[56] In April 1934 Pauli married Franca Bertram in London and in the same year he officially discontinued his analysis.[57]

When Germany annexed Austria, Pauli was not a Swiss citizen but still an Austrian. He applied for Swiss citizenship at the time of the annexation but was turned down. Pauli was therefore obliged to accept German citizenship. Without closer examination he was classified as half-Aryan and thus escaped having to have a J-marked passport. But he knew that under German law he would really be regarded as 75 % Jewish and he did not feel secure in Switzerland. Before the outbreak of the war he had transferred a little money to the USA and so he was glad to accept the offer of a visiting professorship at *The Institute for Advanced Study* at Princeton for the period 1940–42. However it was not an altogether simple matter for Pauli to obtain an entry visa to the USA, as he was officially a German citizen. Moreover his German passport was only valid until 29 November 1940. Eventually, however, he obtained his visa. There still remained the problem of actually getting to America. The usual routes were blocked and aircraft were overfull. Finally Pauli and his wife managed to get from Geneva by land through Spain to Lisbon, where they were able to take a ship. They arrived in the USA on 24 August 1940.[58]

During the period 1940–46 Pauli was employed at *The Institute for Advanced Study*, where he worked in close proximity to Einstein. It was in many ways a difficult period for Pauli. The renewal of his appointment after 1942

[53] Pauli to Delbrück, 6 Oct. 1958 [3075], *PLC IV/4ii.* See also Charles Enz, 'Wolfgang Pauli, (1900–1958): A Biographical Introduction', Wolfgang Pauli, *Writings on Physics and Philosophy*, 19.

[54] See, for example, Pauli to von Franz, 6 Nov. 1953, [1669], *PLC IV/2*, Pauli to Jung, 23 Oct. 1956 [69P], 'Statements by the Psyche', *PJL*, 134.

[55] Enz, 'Rationales und Irrationales', 24.

[56] Pauli to Jung, 2 Oct. 1935 [13P], Pauli to Jung, 27 May 1953 [62P], *PJL*, 10, 121.

[57] By officially I mean that he stopped receiving regular analysis. However he continued to send his dreams to Jung from time to time and to discuss his personal problems with him.

[58] Karl von Meyenn, 'Die Princetoner Jahre und die Rückkehr nach Zürich', *PLC III*, XXVII ff; see also *PLC III*, 125f.

was problematic, there was no money and his future at the Institute was uncertain. He actually considered returning to Switzerland and applied for travel documents, but received none. He felt doubly rejected by Switzerland, which had denied him citizenship in 1940 and now denied him travel documents. With no valid passport he was in effect stateless until 1946 and found himself a refugee. Pauli, who had always taken a very dim view of nationalism, was now confirmed in his dislike of it by his statelessness and his feeling of homelessness.

> There is no home for me – only the profound conviction (which I had even in 1918) that the national form of civilization with its symbols and institutions has become a nonsensical impossibility. Yet somewhere I still wanted to find a conservative solution (and I depended for this on Switzerland), but it is not possible. And in fact I believe that it is against my very 'instincts'.[59]

Pauli was one of the few who did not take part in the Manhattan Project, i. e. the development of the atomic bomb. The fact that all the great physicists except Pauli took part in this project has given rise to some speculation. After the war Pauli was very glad that he had not been involved, but while the war was actually going on he was somewhat uncertain about how to act. This is clear from correspondence between him and Robert Oppenheimer. Oppenheimer's explanation for Pauli's non-participation in this project was that somebody had to carry on pure scientific research and that nobody met this need better than Pauli himself. All the same, it is evident that Oppenheimer did not want Pauli to take part in the project.

> You are just about the only physicist in the country who can help to keep those principles of science alive which do not seem immediately relevant to the war, and that is eminently worth doing.[60]

Oppenheimer went on to suggest that Pauli should publish scientific articles under other names, so that the enemy would imagine that scientists were working as usual and were not involved in military research. How this felt to Pauli is evident in a letter he wrote to Niels Bohr: 'I am very well here and belong to the very few people in the world, which are continuing their pure scientific work during the war. Of course, I am a bit lonesome…'[61]

However other explanations for the fact that Pauli's participation might not have been welcome on the project have been suggested. One might be his known aversion to applied physics. He was very sceptical of 'scientific' ambitions that focus uncritically only on practical results and 'filthy lucre'.

59 Pauli to C.A. Meier, 26 May 1942, (will appear in *PLC suppl.*). See also *PLC III*, 125.
60 Oppenheimer to Pauli, 20 May 1943 [671], *PLC III*, 181.
61 Pauli to Bohr, 3 Nov. 1943 [684], ibid., 203.

To him true science was still linked with a contemplation of the structure of existence, closely associated with man's religious function. The ambition of science must be to discover connections and to place man in a context that is greater than man himself. On the other hand the same can be said of Einstein's attitude, a fact that did not deter him from participation in the Manhattan Project. An explanation of a more controversial nature is the so-called 'Pauli Effect'. The Pauli Effect was a phenomenon said to be linked with Pauli's personality, so inexplicable as to be regarded by most people as a joke. But, as is so often the case, there are real events behind the anecdotes. The Pauli Effect was the explanation given for the fact that things tended to get broken in the immediate neighbourhood of Pauli. Even the most sober experimental physicist considered that a strange influence emanated from Pauli and that his mere presence in a laboratory seemed to cause all kinds of experimental mishaps. It was as if he aroused the capricious nature of the objects. Here I shall quote the views of two physicists on this phenomenon. One is Oskar Klein, Pauli's colleague and close friend, and the other is Markus Fierz, also a friend, colleague and assistant.

Oskar Klein writes:

> How careful one has to be with regard to rules which have been arrived at by an innumerable number of coincidences is perhaps best shown by the fact that it is so easy to produce rules which apparently hold good in a number of instances but which are nonetheless obviously incorrect. I will mention a curious example of such an 'artificial' superstition. An acquaintance of mine has acquired the reputation of being some sort of bird of ill omen in that something always breaks in premises which he enters. There is no end to the true – perhaps sometimes a little embroidered – stories which circulate around this 'effect' of his, which has long been his own pride and joy. Here it was all just a joke, but had the story happened to arise in a circle of people with an interest in the occult, who were inclined to believe that certain demonic individuals can influence their surroundings by exerting mysterious forces, they would have had as well-demonstrated a 'supernatural' effect here as ever there was.[62]

Markus Fierz says:

> It appears that most physicists were not aware that *Pauli* was much more than a very brilliant and in some ways singular theoretician. But they sensed it. For even quite sober experimental physicists were of the opinion that strange effects emanated from *Pauli*. They thought, for example, that his very presence in a laboratory produced all kinds of experimental misfortune, almost as if he aroused the malice of the object. This was the 'Pauli Effect'. His friend *Otto Stern*, for example, the celebrated virtuoso of the molecular beam, would never allow him into his department for this reason. This is no legend, I knew both *Pauli* and *Stern* very well! *Pauli* himself definitely believed in his effect. He told me that the presentiment

[62] Oskar Klein, 'Vetenskap och fördomar', *Nordisk Tidskrift* 10 (1934), 493.