The Innermost Kernel

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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.

[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]

[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.

> of disaster would come to him as an unpleasant tension, and if the anticipated misfortune then actually occurred – to someone else! – he felt strangely released and relieved.[63]

Without entering into a deeper discussion of the Pauli Effect, I believe that it ought to be considered a possible reason for the failure to allow Pauli to work on the Manhattan Project. According to Markus Fierz it was a fact that the molecular physicist Otto Stern refused to let Pauli into his laboratory. It is in my opinion credible that Oppenheimer, too, preferred to be on the safe side and not to let Pauli in on such a sensitive and vital task as the atomic bomb project. Superstition or not, most physicists who do sensitive experiments know that there are many incalculable and unknown factors that can influence the experimental situation. The Pauli Effect is also of interest from a different point of view, namely in relation to Pauli's collaboration with Jung on the synchronicity principle. It is probable that Pauli took a particular interest in Jung's concept of synchronicity just because it concerns random coincidences of the type represented by the Pauli Effect, coincidences which do actually exist, but which Western science considers have to be regarded as 'obviously incorrect', to quote Oskar Klein. I shall return to the concept of synchronicity at a later stage.

In 1945 the Nobel Prize was awarded to Pauli for the exclusion principle, which he had formulated in 1924. At the banquet that was held at the *Institute for Advanced Study* on 10 December 1945 to honour this occasion, Einstein gave an emotional speech in which he called Pauli his 'spiritual son', who was to complete the work he had begun.[64] When Pauli receives news of Einstein's death in 1955 he writes to Max Born recalling this occasion:

> Einstein's death has also touched me personally. A friend so well disposed to me, so *paternal*, is now no more. I shall never forget the speech that he gave in 1945 in Princeton about me and for me, after I had been awarded the Nobel Prize. It was like a king abdicating and naming me as a kind of 'chosen son' as his successor. Sadly there are no notes for this speech of Einstein's (it was improvised and there is no manuscript at all).[65]

We could compare this incident with Sigmund Freud's nomination of Jung as his 'crown prince'.[66] In 1908 Freud writes to Jung: 'My selfish purpose, which

[63] Markus Fierz, 'Naturerklärung und Psyche: Ein Kommentar zu dem Buch von C.G. Jung und W. Pauli' (1979), *Naturwissenschaft und Geschichte* (Basle, 1988), 190.

[64] The reason Pauli could not be in Stockholm at the time was that he was stateless, and so could not travel. By 1946 he had obtained both Swiss and American citizenship and could participate in Nobel festivities of that year instead.

[65] Pauli to Born, 24 Apr. 1955, [2075], *PLC IV/3*. See also Enz, 'Wolfgang Pauli, Physiker und Denker', 9.

[66] Freud to Jung, 16 Apr. 1909 [139F], *The Freud-Jung Letters*, ed. William McGuire (Ewing, 1979), 218.

I frankly confess, is to persuade you to continue and complete my work by applying to psychoses what I have begun with neuroses.'[67] Both Pauli and Jung began as brilliant exponents of the work of their famous mentors, but later turned away from their way of thinking. However it must be emphasized that in many other respects the relationships between Jung and Freud and between Pauli and Einstein show more differences than similarities. Jung was Freud's 'disciple' and 'chosen' during the period 1907–1911, but then 'apostatized' and created his own psychology. Afterwards he and Freud had no more contact with each other. Pauli was of course never a 'pupil' of Einstein in the same sense. However he acquired a thorough understanding of Einstein's theories at a very early stage and was considered one of the few who really understood Einstein.[68] According to Pauli, Einstein tried to the last to win Pauli over to his side, because he felt that Pauli was the physicist who understood him best and who was nearest to his own thinking on physics. Pauli also asserted that he was fully aware of what Einstein wanted and that he understood why Einstein could not accept the quantum theory as complete.[69] Pauli was even inclined to agree with Einstein that the quantum theory *is* incomplete, but on grounds different from Einstein's. Pauli also believed that he understood the non-scientific reasons behind Einstein's refusal to accept quantum physics.[70] It was principally on this point that Pauli was critical of Einstein. What is interesting in this comparison, however, is the *type* of criticism that Pauli and Jung levelled against their 'mentors'. The stumbling block, to both Pauli and Jung, was that the models of their 'mentors' could not cope with the *irrational*, an element which they associated with the occurrence of the 'unique', the ever present creative act of nature, which cannot be grasped within a rational scheme. They also criticized them for their lack of understanding of the role of the observer in science.[71]

After the end of the Second World War and his receipt of the Nobel Prize there were several possibilities open to Pauli. Although he had been offered

[67] Freud to Jung, 13 Aug. 1908 [106], ibid., 168.

[68] See, for example, Max Born, *The Born-Einstein Letters from 1916–1955* (London, 1971), 217.

[69] Pauli says to Schrödinger: 'The opposition to quantum mechanics is of course not unified itself. Of the members of this opposition I understand – or at least I think I do – Einstein the best. I saw him again a year ago at Princeton; I did not share his opinion, but found that he could express very well what he wanted.' Pauli to Schrödinger, 27 Jan. 1955, *[1992], PLC IV/3*.

[70] 'I remarked to Bohr at the time that Einstein was regarding as an imperfection of wave mechanics within physics what is in fact was an imperfection of physics within life. Mr. Bohr readily agreed with this statement. Nevertheless, I had to admit that there was an imperfection or incompleteness somewhere, even if it was outside the realm of physics, and since then Einstein has never stopped trying to bring me around to his way of thinking.' Pauli to Jung, 27 May 1953 [62P], *PJL*, 121.

[71] For Jung's critique of Freud see for instance C.G. Jung, *Memories, Dreams, Reflections*, ed. Aniela Jaffé (Glasgow, 1977), 172ff. I do not go into the question whether this critique is correct or not.

a very good position at Princeton and been granted American citizenship, he decided in 1946 to return to Zürich and his professorship at ETH.[72] He felt that he had no particular nationality, but that he was nevertheless European.

> I wonder how the spiritual side of life will develop in Europe. Are people there very nationalist? For me, of course, it is not possible to consider myself as belonging to a single country (that would contradict the whole course of my life). I feel, however, that I am European. This concept, again, is not recognized in Europe, which makes the situation rather complicated for me.[73]

There was another reason for Pauli's reluctance to stay in the USA. He suspected that research policy in America would not remain free but would come increasingly to be controlled by the government and the military. He speaks of this in a letter to Einstein:

> In addition there was the consideration that it is perhaps in any case a good thing if quite a few physicists remain in Europe. So at last my decision was reached, although in the short term working conditions for scientific physics in America may be very favourable.
>
> In the more distant future (say in about 5 years), however, I do see the big danger of an intervention of the military in physics (with or without the subterfuge of the plain-clothes commission of non-physicists). Certain indications appear unfavourable. The extensive suspension of purely scientific publishing and the 'under cover' work in the university laboratory at Berkeley.
>
> By 'intervention' I do not only mean censorship, but also an influencing of the direction of investigation in experimental work. Even without legal force it is impossible to imagine a united front of physicists against such tendencies; it is too easy to entice young people with good positions and career prospects…[74]

In 1954 he was glad that he had taken this decision in view of what happened to his colleague Oppenheimer, who was persecuted for his political opinions.[75] Although Pauli was not directly involved in the manufacture of the atomic bomb he felt that he was responsible for mass murder – responsible because he felt that he moved in *criminal* circles. Both the USA as a country and physics as a career had become criminal. He felt that his general state of health was deteriorating; he became irritable and often had outbursts of rage. The decision to move back from the USA to Switzerland was undoubtedly influenced by this feeling. Once back in Switzerland he felt a good deal better, but his profession was still burdened with guilt. In 1951 Pauli wondered whether he ought also to 'emigrate' from the narrow physics to a more

[72] For his complicated relationship with the ETH, see PLC IV/1, VIII ff.

[73] Pauli to Casimir, 11 Oct. 1945 [780], *PLC III*, 322. This last comment is especially interesting today with the growing influence of the EU.

[74] Pauli to Einstein, 19 Sep. 1946 [835], ibid., 383.

[75] Pauli to Fierz, 23 Apr. 1954 [1771], *PLC IV/2*.

spiritual domain.[76] Pauli also had his own particular view of the physicist's relationship with politics. In the 1950s many physicists felt called upon to warn the politicians against armament, nuclear weapons and other dangers. Petitions were organized, signed by all the great scientists, especially Nobel prizewinners. Pauli did not sign any of these lists. His main reason was that it is impossible to work against the politicians' striving for power by becoming involved in it oneself, particularly if this is not one's main task. The only result will be that one becomes a victim of what one is trying to oppose, i. e. the lust for power. Pauli is here taking, as on so many other occasions, an attitude borrowed from Chinese hilosophy: the right tool in the hands of the wrong person makes the right tool wrong. Quite simply, he did not think that the appeal of physicists to politicians would have any effect at all. It is better to leave politics to the politicians and to remain on the periphery of this uncomfortable and dangerous machinery.[77] To Niels Bohr he wrote:

> But it seems to me that your effort to intervene directly in the course of historical events is a textbook example of the wrong path, and is doomed to failure from the outset (glad as I am that your earlier efforts in 1944 have now become known to the public). Your suggestions *presuppose* that the mistrust of the 'starry ones'*[78] has already been replaced by a trust, but are not designed to *lead to* this trust in those unintelligent people who now have to decide on such steps and in current 'public' (= collective) opinion. *Whoever wants to oppose the 'will for power' with something else, something spiritual, must not himself show such a will for power that he credits himself with a greater influence on world history than he can have*. (There are situations where a small majority may be decisive, but today's is *not* such a one.) A Chinese proverb says: 'If the right tool is in the hands of the wrong man, the right tool has the wrong effect.' Therefore one does not put any tool in the hands of the 'wrong' man; it will not lead to success.
>
> This position of mine is *not* synonymous with hopelessness: on the contrary, in a historical crisis such as today's we are not in a position to make prophecies at all.[79]

Pauli recommended what he called an *indirect* influence, i. e. the influence that proceeds from one's own personality – how one lives and the ideas which one conveys to those to whom one is closest. This idea, too, was obtained from Chinese philosophy: the best ruler is the one whom nobody notices.[80] He considered that every individual had to shoulder his own responsibility, rather than hide in large groups or behind certain social 'programmes'.

[76] Pauli to von Franz, 17 May 1951 [1239], *PLC IV/1*. See also Herbert van Erkelens, 'Pauli und Jungs Antwort auf Hiob', *Der Pauli-Jung Dialog*, 69 f.

[77] Pauli to Bohr, 6 Jun. 1950 [1120], *PLC IV*.

[78] * This refers to the fact that both the USA and the Soviet Union used stars as symbols, white and red respectively.

[79] Pauli to Bohr, 3 Oct. 1950 [1158], *PLC IV*.

[80] Pauli to Bohr, 6 Jun. 1950 [1120], ibid.

Instead of taking part in such big projects with all the great scientists Pauli preferred membership of small groups of ordinary people, who adhere to their values whether they have found success in life or not. During his period of residence in the USA Pauli had joined such a group, which called itself 'the Society for Social Responsibility'. He writes to Bohr:

> But this attitude of lone wanderer forces me into a largely passive spectator attitude to the public: my influence should consist in what I *live*, what I *believe* in and what ideas I more or less directly spread to a small circle of students and acquaintances – not in addressing the general public. Therefore I should also like to avoid signing any kind of 'public letter'. (I do not exactly want to make an 'absolute principle' out of it, but I have a strong aversion to appearing in public.)
>
> I know, I suppose, that my position is extremely individualistic, extremely 'passive' and certainly not the only one possible.[81]

According to Jung's colleague Marie-Louise von Franz, Pauli suffered a further period of depression towards the end of his life, together with a blockage of his scientific creativity. She says that he then began drinking again, which led to his premature death in 1958.[82] Others believe that it was Pauli's inability to stand up in public for C.G. Jung's psychology, or fear of having to do so and thus risking his position as the highest critical authority in physics, that led to his depression. Yet another view is that Pauli tried to turn Jung's psychology into a rational philosophy instead of committing himself one hundred percent on the personal level. The theory here is that Pauli's depression was caused by the fact that he never completed what he had begun, that he was unable to pursue his work on the unconscious to the end.[83] Most of these suggested explanations appear both speculative and simplistic. However there seems to be agreement that Pauli was not really himself in the months before his death. Many consider that the unsuccessful collaboration with Heisenberg in 1957–58 on the unified field theory may have affected his frame of mind, although nothing in Pauli's letters from this period indicates that he was in a state of serious depression. Pauli was taken ill suddenly on 8 December 1958 and died of cancer of the pancreas after a short period in hospital on 15 December 1958.[84]

[81] Quoted in Armin Hermann, 'Paulis Auffassung von der Rolle der Wissenschaft', *Wolfgang Pauli: Das Gewissen der Physik*, 16. Cf Pauli to Born, 21 Jan. 1951 [1195], *PLC IV/1*.

[82] 'Letter to the Editor from Marie-Louise von Franz', *Psychological Perspectives* 20 (1988), 377.

[83] Marie-Louise von Franz, 'Reflexionen zum ›Ring i‹', *Der Pauli-Jung Dialog*, 331 f.

[84] Enz, 'Rationales und Irrationales', 26.

A Child of His Time: Fin-de-siècle Vienna

We shall first take a closer look at Pauli's philosophical background and then move on to place him in the broader context of the intellectual climate of the turn of the century. The purpose of this is first to identify the factors which led Pauli to feel an affinity with the psychology and worldview of C.G. Jung and second to give an idea of the main philosophical issues that were being discussed as Pauli grew up. Among other things I wish to show that Pauli's interest in Jung cannot be seen as solely the product of his personal crisis. The perspectives examined by Jung are in fact quite close to the questions which occupied Pauli in connection with the development of physics – perspectives and questions which were accentuated by his stay and association with Niels Bohr. What is more, Pauli had, even before coming into contact with Bohr, a philosophical outlook of his own which marked his attitude to physics and which also left its traces on the philosophy of the Copenhagen School.

Pauli was born in 1900 and grew up in one of the great metropolises of the Europe of the day: Vienna. In turn-of-the-century Vienna the values and truths of the old world were being questioned. Among the subjects debated were power relationships, the function of art, the link between language and message and between perspective and reality and the limits of man's ability to acquire objective knowledge. A recurrent theme was the relationship between surface and depth, form and content, subject and object. Vienna, especially, was at this time a melting pot where the old battled with the new, a place where a new view of humanity, society, science and a new revolutionary art were emerging. The work of Søren Kierkegaard, Arthur Schopenhauer and Ernst Mach inspired the young people of Vienna. During his life Wolfgang Pauli came under the influence of all three of them, especially Schopenhauer and Mach. Many have chosen to characterize this *fin de siècle* spirit as one of subjectivity, 'irrationalism' and 'anti-intellectualism'.[85] The period has also been labelled the time of 'the revolt against positivism', because there is

[85]See, for example, Stuart Hughes in *Consciousness and Society: The Reorientation of European Social Thought, 1890–1930* (New York, 1958), 66; Franklin L. Baumer, *Modern European Thought, Continuity and Change in Ideas 1600–1950* (New York, 1977), 371 ff; Paul Forman, 'Weimar Culture, Causality, and Quantum Theory, 1918–27: Adaptation by German Physicists and Mathematicians to a Hostile Intellectual Environment', *Hist. Studies Phys. Sci.* 3 (1971), 45–46.

a lot of criticism of the belief that science can solve every problem and give us certain knowledge and a verifiable world. Many of the thinkers of the era frankly declare their abhorrence of positivism. But we cannot today use the label 'the revolt against positivism' when speaking of this period unless we expressly exclude the new positivism which was propounded in turn-of-the-century Vienna by Ernst Mach and the Vienna Circle. In Ernst Mach's philosophy we find a typical representative of the new current of ideas that reflects the spirit of the period. Many commentators try to depict an antithesis between positivism and the anti-intellectual, existential outlook on life that flourishes at this time. However it becomes difficult to hold this dividing line if one bears in mind that the new positivism shows some important points of contact with existential philosophy in its claim of returning to 'direct experience' and 'the immediately given'.[86]

Pauli's contribution to quantum mechanics had, as we shall see, a typical 'Viennese' stance. Let us start with Pauli's own description of his philosophical background. 'My own philosophical background is a mixture of Schopenhauer (minus the determinism of his times), Lao-Tse and Niels Bohr', Pauli writes to his colleague Victor Weisskopf in 1954.[87] The historian of science Max Jammer believes that physicists traditionally refrain from acknowledging adherence to a specific school of philosophy even if they are aware that they belong to one. In general they deny the influence of a particular philosophical climate on their scientific work although it may have been of crucial significance.[88] This does not apply in Pauli's case. There are several places in his correspondence where Pauli refers to the thinkers who have most influenced him as a person and a scientist. The fullest example of this is to be found in a letter to the philosopher H.L. Goldschmidt:

> What has really made an impression on me philosophically I can indicate only quite briefly in a letter: the Mach (empiricism) – Plato (the idea of 'the heavenly place') antithesis; Kant (the preconditions of the science of his time are dogmatically established and mistakenly passed off as the preconditions of human reason per se; the a priori is attributed to rationally formulated ideas) – modern psychology of the 'unconscious' (Freud, C.G. Jung) (the a priori 'archetype' as a path for the presentation of preexisting images as in Plato, Proclus, Kepler). Then: Enlightenment (Voltaire, Mach) – on the other side Vedanta doctrine, Schopenhauer ('will' as his God). (NB. Bernard Shaw's observation that the unmasking of a celestial Hauptmann von Köpenick in no way proves that no true Hauptmann existed, I made a note of this.) The East as a whole has made a strong impression on me, China even more than India, both the ideas of I-Ching (Yin-Yang polarity)

[86] See, for example, Forman, 45–46.
[87] Pauli to Weisskopf, 23 Feb. 1954, *[1725], PLC IV/2*.
[88] Jammer, 166.

and also Lao Tse. Schopenhauer's attempt to bring Kant and Buddhism under one umbrella I found very interesting, but, owing to Kant's recalcitrance and Buddha's passivity in the face of the world, not successful. Generally the seventeenth century (together with many of the ancients) means a lot to me, the nineteenth century little. German intellectuality has always seemed to me inclined to dogmatism and to non-instinctual one-sidedness. How different were the ways of the Chinese! And everything collective on a big scale is quite simply very alien to me. It seems to me moreover that feeling goes as deep as thought and that an 'amo, ergo sum' might be just as justified (or unjustified) as the 'cogito, ergo sum' of Avicenna-Descartes. (N.B. Pathological exaggeration of the thinking function in Hegel.)

I have been in this atmosphere, which *seeks an equilibrium between opposing pairs*, since my earliest youth. That's why much of what you commend as great modern achievement seems to me fairly self-evident. So your remarks on p. 30 f, about a truth and *the* truth, which are followed on p. 42 by the concern with the concept of plenty, take me back to those days in 1923 when I was working in the laboratory of Niels Bohr. For he used often to quote Schiller's 'Sayings of Confucius': 'The full mind alone is the clear, and truth dwells in the deeps',[89] to which he attached lengthy philosophical expositions. These culminated in a proposition which he later called 'the complementarity between clarity and truth': if an assertion is too clear, then there is something wrong with its accuracy, and if an assertion is true, then its clarity is limited. For every truth also contains in part something unknown, only glimpsed and therefore also a hidden opposite to its conscious meaning. (I now believe that is just what psychologists call 'symbol', which does not seem to me to be so very different from what mathematicians call 'symbol'. See below.)

In those days I often passed with more respect than affection the monument to Søren Kierkegaard (in front of the Danish parliament building), whom you often mention in your book. In his early youth my tutor, Bohr, had taken a passionate interest in this compatriot of his (he also gave me 2 volumes of this writer in Danish in 1930 – but I did not get very far with this reading); but that was earlier, in the past and far removed from me. I can recommend Bohr's book 'Atomtheorie und Naturbeschreibung' (Verlag Springer, 1932, it is a collection of lectures) to philosophers with an interest in modern physics. (I could not find it in your list of literature.)[90]

Here we are given a compact summary of the philosophical influences on Pauli. How they are to be ranged chronologically is more difficult to decide. We know that Ernst Mach was among the very earliest to make an impression on him and there is no doubt that he read Arthur Schopenhauer while still very young. Enlightenment thinkers and the 'socialist' writer George Bernard Shaw were other early influences, possibly largely from his mother's side, as she was a socialist. Pauli describes himself as a 'cold and cynical devil', a 'fanatical atheist' and an intellectual 'enlightener' in his younger years.[91] What might be added here, although not mentioned by Pauli in his letter

[89] Original in German: 'Nur die Fülle führt zur Klarheit – und im Abgrund wohnt die Wahrheit'
[90] Pauli to Goldschmidt, 19 Feb. 1949, Goldschmidt, 25.
[91] Pauli to Jung, 24 May (1939) [30P], *PJL*, 27.

to Goldschmidt, is that the mathematician Henri Poincaré was among the favourite authors of his youth.[92] Below we will take a closer look at Poincaré's philosophy, as it shows some similarities with the thinking and ideas of Jung. In addition Pauli borrowed concepts from Poincaré to illustrate the psychological processes that Jung described. How early Pauli came into contact with oriental ideas is difficult to say. Many of his generation became aware of Indian and Chinese philosophy via Schopenhauer. We also know that Niels Bohr spoke admiringly of Lao Tse. Notwithstanding this, I suspect that Pauli's deeper reading of Chinese wisdom, in particular, did not begin until after he had come into contact with the ideas of Jung. It is interesting, however, that one of the central themes in the exchange of ideas between Pauli and Jung, namely the principle of synchronicity and its crossing of psychophysical boundaries, has its precursor in Schopenhauer and his essay *Über die ausreichende Absichtlichkeit im Schicksale des Einzelnen* – a text to which Pauli often referred in this context.[93]

Pauli turns out to be not only a shrewd mathematician and theoretical physicist but also a humanist with a bent for philosophy and even something of a poet.[94]

He was fascinated by the development of Western ideas in the areas of science, philosophy and religion and was also a lover of literature. He appears to have inherited the interest in philosophy and literature from his mother,

[92] Pauli to Dyson, 18 Feb. 1951 [1203], *PLC IV/1*. 'My favorite author was H. Poincaré (mostly: 'Méthodes nouvelles de la mécanique céleste' - canonical transformations, semi-convergent series. Until to day I like them more than the convergent ones!)'

[93] Arthur Schopenhauer, *Parerga und Paralipomena* I (1851), (Leipzig, 1922).

[94] Pauli had had certain ambitions as an author, having tried to write short stories and poems. Some of the poems have survived. Cf Karl von Meyenn, 'Ist die Quantentheorie milieubedingt?', *Quantenmechanik und Weimar Republik* (Wiesbaden, 1994), 18 footnote 24. Here is an example from a letter sent to Aniela Jaffé on 16 Nov. 1950 [1166], *PLC IV/1*.

'Princeton, N.J. October 1942
Indian Summer
Der Jugend ungestüm und wirr Verlangen
ist wie des Sommers Glut hinweggegangen.
›Die Luft ist mild‹, das Laub wird farbenprächtig.
Gelöste Seele fühlt sich wieder trächtig. Sie spricht geformte Worte, die verkünden Und läßt, was Menschen quält und trennt, entschwinden. Geklärter Sinn gibt richtiges Erkennen
Die off'ne Tiefe kannst du Liebe nennen.'

Desires of youth, impetuous and wild
Like summer's heat have passed. 'Mild
Is the air', and autumn leaves afire
The recreated soul once more inspire.
To speak in measured words, enunciating
And all that torments and divides abating.
A clearer mind may properly confess
The open depth you may with love's name bless.

who read Arthur Schopenhauer and Henrik Ibsen. Pauli's surviving library also contains such authors as Friedrich von Schiller, Goethe, G. E. Lessing, Knut Hamsun, Gustav Meyrink, Bernard Shaw and John Galsworthy. Much of this literature had presumably been read by Pauli's mother and passed on to her son. In later years Pauli liked reading Aldous Huxley, C.S. Lewis, Charles Morgan and Sinclair Lewis.[95] Before Pauli entered analysis he had started reading Jung and attended his lectures. In 'La Salle Pauli' at CERN, where his scientific and private library is kept, there are seventeen works by Jung, most of them with notes in the margin. The first book he read was probably *Symbole und Wandlungen der Libido* (Symbols of Transformation), the work which initiated Jung's break with Freud.

The psychoanalysis of Sigmund Freud is an excellent example of the *Zeitgeist* of *fin de siècle* Vienna. Many were looking for something real and authentic behind inhibiting and rigid structures. Society, sexuality, gender roles and even the rational functions of man, logical and abstract thinking, were seen as suffocating structures.[96] Man was looked on as the constructor of reality. Beyond these structures, it was felt, was to be found the flow of life itself, an irrational force identical with true nature. Knowledge and science were seen as human activities, as a need to structure and control existence, not as a discovery of what is really there. In contrast to the unbounded belief of the Age of Enlightenment in man's ability to ascend to ever-greater heights with the help of reason, the talk towards the end of the century was of man's limitations. All the faculties that had been uncontroversially regarded as man's instruments for controlling and understanding the world were now questioned: consciousness, reason, language. With the 'discovery' of the unconscious and, with it, the irrational in man, the view of the human psyche became problematic. There was something more behind man's well-polished, civilized and rational facade. It was realized that man had cocooned himself in a myth about himself and about his ability to comprehend the world in rational categories.

[95] The books are in 'La Salle Pauli', CERN.

[96] Henri Bergson, for example, represented the point of view, that thinking gives only a very limited kind of knowledge, whereas intuition, which is something irrational, puts us in contact with the innermost flow of life and thus gives us absolute knowledge. See Henri Bergson, 'L'introduction à la métaphysique' in *La Pensée et le mouvant* (Paris, 1911). Freud stated both that man is unhappy because he suppresses his instincts with the aid of reason and also that this reason (the superego) is all that protects man from these instincts, which are of a chaotic, primitive and destructive character. See Sigmund Freud, 'The Future of an Illusion' (1927), 'Civilization and its Discontents' (1930), *Civilisation, Society and Religion: Group Psychology, Civilization and its Discontents and other Works*, ed. Albert Dickson & Angela Richards (London, 1985), 181–241, 245–340.

The old structures appeared devoid of content and they were falling apart. This created pessimism and dread (*Weltschmerz*) in some, optimism and *Schadenfreude* in others, who did their best to expedite the decay of the eroding conventions. In Friedrich Nietzsche, the turn-of-the-century philosopher *par excellence*, we find nearly all the characteristic features of the *fin de siècle* spirit. He criticized all the touchstones of the Age of Enlightenment: reason, progress and science. We find in him the seeking for the true and the living beyond the facades of the rational, the criticism of the idealism/materialism dichotomy of academic philosophy, the attack on the view of history, the linguistic criticism, the emphasis on man's instinctive and irrational nature and the importance of action, life and practice. Modern man is regarded by Nietzsche as disoriented and disillusioned, evicted from the safe harbours of religion, science and metaphysics – facing the unknown, open and dangerous sea.[97] Man stood at once alone, forced to rely entirely on himself, on his own *experience*. He had as it were to begin again from the beginning and he could only do this by returning to the directly given, going back to the most fundamental and original.

Around the turn of the century there was a movement to throw off the shackles of philosophy and concentrate on what experience reveals. Many wished to stake out a field of activity and create new disciplines by drawing a line towards philosophy and its deductive procedures. It was emphasized that one had to start from what was directly given and study 'the phenomena' i. e. use the inductive method. The concept of experience, however, acquired different connotations in different fields. Experience in the sense of 'feeling', 'life-force' and 'intuition' was the mark of the vitalists. Experience in the sense of 'sensory impression' was characteristic of empiricism, Mach's phenomenalism and of impressionism as an art form. Whereas intuition is seen as a means of getting in touch with the directly given, for the vitalists the creative flow of life, the sensory impressions are regarded as the directly given itself. In both cases the directly given is described as an irrational flow which links subject and object in a uniform reality. In liberal theology and psychology of religion it is emphasized that man has to look to himself and that he cannot rely on the church as an institution or dogma. He must himself decide on and rely on his *own experience* of God or the divine.[98] William James stated that the psychologist of religion should first study the religious phenomena and not try to reduce them to a particular explanatory model. He

[97] Friedrich Nietzsche, *Die fröhliche Wissenschaft* (1882), (Stuttgart, 1965), section no. 124; 343; 347; 377.

[98] Albert Ritschl, Adolf Harnack, Paul Tillich, Rudolf Otto, William James.

believed that the core of religion is the religious feeling, with emphasis on the individual mystical body of experience. This experience has to be regarded as a phenomenon in its own right and must not be derived from any other causes. James also said that religion is largely a need that finds expression in religious customs. Religion is a practice, a way of life. Therein lies the value and truth content of religion. A religious phenomenon is true if it fulfils this vital function.[99]

In philosophical phenomenology the concept of 'experience' is equated with 'grasping of essences'. Experience is the genuinely immediate experience of the directly *given,* 'pure phenomena' which we perceive in the cognitive act as objects of consciousness. Edmund Husserl compared his phenomenological philosophy with that of the positivists: 'If positivism means absolute unconditional justification of all sciences by means of the 'positive', that is to say the originally experienceable, then we are the true positivists.'[100] But the observer must not be seen as a passive spectator. Scientific activity is a creative process, since it contains a large portion of intentionality. Existentialism in the Kierkegaard version stresses that man constructs his own reality by making a free choice. The perception of reality is fully tied to the circumstances of the observer. The biologist Jacob von Uexküll believed that every species of animal has its own specific spatial perception that varies with the animal's unique physiology. Sociologists and ethnologists studied the organization of space in different cultures. The sociologist Émile Durkheim, for example, believed that all fundamental categories of perception, even logic, have a social origin. In art, man the designer is emphasized in the new abstract movements such as cubism, Bauhaus and constructivism. Philosophers such as Nietzsche and Ortega y Gasset developed a philosophical perspectivism that assumes that there are as many spaces as there are viewpoints.[101] The position of man as a social being is also seen as problematic. Marcel Proust peaks of the difference between how man 'appears to be', his behaviour, and how he really is, which makes real contact between individuals impossible.[102] A growing interest in the relationship between the individ-

[99] William James, *The Varieties of Religious Experience* (1901–02), (Glasgow, 1960).

[100] Edmund Husserl, 'Ideen zu einer reinen Phänomenologie und phänomenologischen Philosophie' (1913–1930), *Husserliana*, III, ed. Walter Biemel (The Hague, 1950), 46. Original in German: 'Sagt 'Positivismus' soviel wie absolut vorurteilsfreie Gründung aller Wissenschaften auf das Positive, d. i. originär zu Erfassende, dann sind wir die echten Positivisten.'

[101] Jacob von Uexküll, *Umwelt und Innenwelt der Tiere* (Berlin, 1909), 195; émile Durkheim, *The Elementary Forms of the Religious Life* (1912), (New York, 1965), 489–492; Friedrich Nietzsche, *On the Genealogy of Morals* (1887), third essay, section 12, José Ortega y Gasset, 'Verdad y perspectiva', *El Espectador*, 1 (1916), 10ff.

[102] Marcel Proust, *A l'Ombre des jeunes filles en fleur*, part III.

ual and society caused the relatively new science of sociology to grow and expand.[103] Around the turn of the century we see a search of meaning and value in imagery, symbols and myths. Pictorial art (painting and sculpture), verbal art (poetry) and tonal art (music) were claimed to embody all that was of real value. In Vienna at the turn of the century aesthetics was equated with ethics, only art could still convey a truly genuine and valuable message. The well-defined logical language, that is, the word, was discredited in favour of the inexhaustible and living figurative and poetic language. Art replaced religion as the only thing that could transcend the concrete, superficial structures.[104] Sorel, Durkheim, James, Nietzsche and Jung emphasized the significance of symbolic images and myth as a driving force of society and of history.

During the inter-war period this 'problematization of man' was given added force by the long drawn out campaigns of attrition of the Great War, in which the combination of old and new warfare ground asunder the last shred of belief in the constant progress of human reason, science and technology.[105] This period is characterized by *loss of visualization*, i. e. the growing tendency towards abstraction, formalization and mathematicization that occurs in various disciplines after the First World War. The celebration of the figurative seems then to decline. Graphic images are broken up and replaced by increasingly abstract, absurd and ambiguous ones, as in, for example, Dadaism and Surrealism. The anthropologist and structuralist Claude Levi-Strauss peeled away the content of the mythic images and stated that they are made up of abstract structures, which are controlled by a set of laws whose components are interchangeable.[106] The author James Joyce did not use the written word to convey visible, well defined courses of events, but dissolved all solid structures by letting the words form a flow of ambiguities which erase the boundaries between subject and object. In his work we do not meet a subject that relates to an ambiguous world. It is rather the multi-dimensional perspective that is the 'subject' of the story. The relativization of all recognizable forms was both cause and expression of a feeling of alienation and dread. It was no longer possible to explain alienation as a result of life-stifling, rational structures that we had ourselves created. Instead it was stated that alienation forms the very essence of human destiny. Admittedly the existentialists believed that man is

[103] Gustave Le Bon, William McDougall, Émile Durkheim, George Sorel.

[104] Janik & Toulmin, 197.

[105] By old and new warfare I mean the combination of the classical pitched battle with the new technological advances such as, among others, the aeroplane, the tank, the machine gun.

[106] Raphael Staude, 'From Depth Psychology to Depth Sociology: Freud, Jung, and Lévi-Strauss', *Theory and Society* 3 (1976), 303–338.

free, but this freedom consists in fact only of the freedom to construct one's own reality. By doing this one defies meaninglessness, although it is actually absurd to do so. Man's position in the universe was more problematic than ever. Heidegger said, 'No time has been so dubious to man as ours.'[107]

During the inter-war period much attention was paid to questions concerning the nature of man.[108] A plethora of lectures and literature had revealing titles such as *What is Man? The Nature and Destiny of Man*, *The Human Condition*, *The Stature of Man*, *Modern Man in Search of His Soul*, and so on.[109] The spirit of the inter-war period might be characterized as 'epistemological desperation'.[110] The key question concerned the boundaries of human knowledge, in particular the boundaries of different types of knowledge in different areas. In sharp contrast to the Enlightenment belief in the unlimited possibility of progress to perfection offered by reason and rationality, interest at the turn of the century, and more so during the inter-war period, was focused on the limited areas of application of various methods. This tendency may be said to have been towards 'specialization', a specialization intended to secure those methods of gaining sound knowledge, which remained after the collapse of the epistemological ideals of the Enlightenment at the turn of the century.

The question that was asked was: 'What is meaningful?' The answers varied according to the attitude to rational and scientific knowledge. The existentialists, for example, were opposed to the increased specialization of scientific knowledge and its higher level of abstraction and, with it, its inability to give people a comprehensible view of the world. To them scientific knowledge was meaningless. They rejected both materialism and idealism and believed that true philosophy must devote itself to the search for man's 'authentic existence'. By identifying natural science with the old positivist ideal of science, i. e. with materialism and determinism in general, and with the impersonal in particular, they failed to notice that the representatives of natural science had begun to reason in a similar fashion.

Unlike those who quite simply rejected natural science, its representatives or defenders, like the Vienna Circle, tried to determine the area and the precise limits within which rational/logical/mathematical methods could give positive or meaningful knowledge. They shared many assumptions with those who dismissed science; materialism and idealism were rejected and they

[107] 'Keiner Zeit ist der Mensch so fragwürdig geworden wie die unsrigen'. Martin Heidegger, *Kant und das Problem der Metaphysik* (Bonn, 1929), 200.
[108] Max Scheler, Ernst Cassirer, Martin Buber et al.
[109] Baumer, *Modern European Thought*, 418.
[110] Ibid., 419.

sought the meaningful or genuine, that which can be positively established – a sound platform in a world that was hard to comprehend. Instead of taking up a position *outside* the rational there was an effort to define the area of application of the rational system and its limits *from within* the system itself.

Arthur Schopenhauer

> '. . . the contradiction between the goodness of God and the misery of the world, as also that between the freedom of the will and the foreknowledge of God, is the inexhaustible theme of a controversy, lasting nearly a hundred years [. . .]. The only dogma fixed for the disputants is the existence of God together with his attributes, and they all incessantly turn in a circle, since they try to bring these things into harmony, in other words, to solve an arithmetical sum which never comes right, but the remainder of which appears now in one place, now in another, after it has been concealed elsewhere.'[111]

The philosopher Arthur Schopenhauer was read and debated by many members of Pauli's and Jung's generation. Schopenhauer saw it as his mission to take up and develop philosophy where Kant had left off. His best-known work, *The World as Will and Representation*, represents a fusion of Kant's ideas with those of oriental philosophy. Both Pauli and Jung had read Schopenhauer and taken him to their hearts.[112] Therefore Schopenhauer also forms one of the links between Pauli and Jung and provides part of the explanation of why Pauli could feel attracted by Jung's psychology. Schopenhauer uses the concepts *will* and *representation* to explain reality and man's ability to understand it. He describes *will* as a blind drive to exist, manifesting itself in all of the world's phenomena, which appear to us as representations. Schopenhauer stresses that by proceeding from the *representation* as the first fact of consciousness it is possible to avoid the dichotomy between subject and object and thus avoid the pitfalls of both materialism and idealism. In the representation the subject is united with the object and they therefore presuppose each other and have no independent existence.[113] Our visible world of representations is identical with the world of phenomena, i.e. the multiplicity of individual objects in time and space. All the same, these are in the last

[111] Schopenhauer, *The World as Will and Representation*, vol. I (1966), 2nd ed. (New York, 1969), 406–7.

[112] Inspection of Pauli's private and scientific library 'La Salle Pauli' at CERN indicates that it was the works *Parerga und Paralipomena* I+II and *Schriften zur Naturphilosophie und Ethik* which occupied most of his attention. Jung seems on the other hand to have been most inspired by Schopenhauer's *Über den Willen in der Natur*, published in 1836. C.G. Jung, *Analytical Psychology: Notes of the Seminar Given in 1925*, ed. William McGuire (Princeton, 1991), 4.

[113] Arthur Schopenhauer, 'Über die Vierfache Wurzel des Satzes vom zureichenden Grunde' (1813), *Kleinere Schriften, Sämtliche Werke III* (Stuttgart, 1962), §19, 44 ff.

resort only an expression of an underlying invisible world, the one that forms the innermost essence of reality, the thing-in-itself. This is the *will*, a blind existence that forms an omnipresent entity beyond time, space and individuality.[114] Schopenhauer emphasizes that consciousness only forms a thin crust on our mental life. In many of his descriptions 'will' is also compared with the sexual impulse. For these two reasons Schopenhauer is usually considered to point the way to psychodynamic psychology.[115]

Schopenhauer's 'will which reveals itself in representation' aroused in Jung the idea that mental energy has its origin in the unconscious and that it always comes to us in a particular form – shaped in specifically defined and visible complex structures which he at first called *primordial images*, later renamed *archetypes*. The former was a term he had borrowed from Goethe. In 1921 Jung defined his term *image* by quoting a long passage from Schopenhauer in which the latter explains the difference between *concept* and *idea*. Schopenhauer compares the *concept* to an inert receptacle, which is in a ratio of 1:1 to its contents. The concept is an intellectual construction from which no more can be taken out than was put in. The *idea*, on the other hand, is compared to a living, self-developing organism endowed with generative power, constantly bringing forth new notions.[116] This corresponded to what Jung meant by image. Jung took particular note of Schopenhauer's later work *On the Will in Nature*. Here he found Schopenhauer departing from his view that the force of life is totally undirectional. 'Will' here acquires instead a specific purpose. From Eduard von Hartmann Jung then took the complementary conception that the 'will' or the 'substance of the universe' is not only a natural force in opposition to reason, but also contains a spiritual quality or intelligence.[117]

However it is particularly in the assertion of the dark principle, the suffering and the evil, that both Pauli and Jung take Schopenhauer to their hearts. On the other hand they both rejected Schopenhauer's determinism, which they consider to be an unavoidable contemporary feature of his philosophy.[118]

[114] Ibid., 805–806.

[115] Idem, 'On the Associations of Ideas' (1844), *The World as Will and Representation*, vol. II (1966), 2nd ed. (New York, 1969), 135–36. See also Henry F. Ellenberger, *The Discovery of the Unconscious* (New York, 1970), 209.

[116] Jung, 'Psychological Types', *C.W.*6, §752. Cf. Arthur Schopenhauer, *The World as Will and Representation* (1818), vol. I (1966), 2nd ed. (New York, 1969), 235 (§49).

[117] Jung, *Analytical Psychology: Notes of the Seminar Given in 1925*, 4.

[118] See for example Pauli to Jung, 28 Jun. 1949 [37P], *PJL*, 38; Pauli to Jung, 27 Feb. 1952 [55P], ibid., 75; Pauli to Weisskopf, 23 Feb. 1954, *[1725], PLC IV/2*. In a letter from Markus Fierz to Pauli, in which he discusses Schopenhauer, Pauli has made a note in the margin that: 'Dogmatischer 'Determinismus' war historisch notwendig' [Dogmatic 'determinism' was historically necessary]. Fierz to Pauli, 23 Oct. 1951 [1298], *PLC IV/1*.

Jung emphasized in lectures delivered while still a student that every genuine philosophy and religion is wrapped in the earthly garment of pessimism. This is the only mode of viewing the world befitting a man aware of his nothingness. Unqualified optimism is not only an indication of naive stupidity but is also an insult to humanity. Jung takes Schopenhauer's fundamental pessimism as evidence that he had a deep insight into the inner conflicts of the human heart – that he was responsive to the dissonances of human life, i.e. that he had insight into the dualism that man experiences in his alienation from existence.[119]

Thinking in opposing pairs permeates Jung's work. The dark has to man as great a degree of reality as the light – to say otherwise is to simplify and falsify human experience. Many of Jung's later works, particularly his critique of Christianity, deal with this subject. Here he torments himself over the Christian theory of *privatio boni*, that is to say the theological doctrine that describes evil as merely an absence, a privation, of good. It does therefore not recognize evil as a force of the same rank as good.[120] Only with an acknowledgment that man is confronted with, indeed even torn apart by, the tension between an evil and a good that are equally real, is his actual experience given validity and his suffering dignity. Despite this point of view Jung did not consider himself a dualist. Experiencing the world in terms of opposing pairs is the condition of our cognition. This cognitive dualism makes no statement on what reality in itself looks like. In actual fact it is more probable that the reality beyond consciousness does not possess such polarities. When Jung postulated a reality beyond consciousness he always spoke of a unified reality, of *the Self* or later of *Unus Mundus* (one world). Jung's unified reality is described as a *complexio oppositorum*, which contains the opposites in a living dynamic whole.[121]

It is not hard to understand that Pauli loved 'his' Schopenhauer when one reads portrayals of the young Pauli's personality. His acerbic, withering criticism and sarcastic humour were something that people enjoyed but were also wary of. Pauli often writes with as much fire and fury as Schopenhauer of what he sees as foolish narrow-mindedness and naivety. Thus he criticizes the theories of his colleagues as relapses into primitive mythology, just as Schopenhauer raged at the scientific philosophies of his time which in a spirit of naive realism traced the origins of organic life back either to a kind

[119] Jung, 'Thoughts on the Nature and Value of Speculative Inquiry', *C.W.A*, §199, 299; Schopenhauer, *The World as Will and Representation*, vol. I, 326 (§59).

[120] C.G. Jung, 'A Psychological Approach to the Trinity' (1948), *C.W.*11, §247 ff.; idem, 'Aion: Researches into the Phenomenology of the Self', *C.W. 9 II*, §74 ff.

[121] Ibid., §112.

of mechanistic game of chance or to God's ingenious Creation.[122] Just like Schopenhauer, Pauli was particularly indignant at the lack of epistemological insight in his colleagues, as here in his criticism of Carl Friedrich von Weizsäcker's *Die Geschichte der Natur*.[123]

> In a very negative sense, however, von Weizsäcker's mental attitude seems to me to be 'German'. I have now read his little book 'Die Geschichte der Natur' and am quite horrified! It is a return to the 19th century, when religion and science dwelt in separate compartments of the human soul – greeting each other politely from afar with repeated assurances that they had nothing to do with each other – and when the soul appeared to lie outside the boundaries of science! With the aid of this hackneyed mumbo-jumbo and his guilty conscience well out of sight von Weizsäcker now makes a pathetic rehash of Clausian heat death (hushing up Boltzmann's criticism entirely!) and the 'Mosaic tale of creation' (here I quote my Schopenhauer), into an argument that the one supports the other and vice versa with a hypocritical 'God is Love' as the conclusion! And enthroned high above them all – unassailable and absolute – is time!
>
> Hot and salty, welling from the author's eye,
> A tear drips unction on his canting book.
> (freely adapted from Polgar)[124]

Pauli was particularly annoyed by von Weizsäcker's classical separation of religion and science with watertight bulkheads. Pauli saw such a simple distinction as an antiquated relic of the nineteenth century. This in combination with the description of God as 'love' was enough for Pauli to hit the ceiling. The most important thing about Schopenhauer was, to Pauli, the fact that he insisted on the existence of evil.[125] Few things aroused Pauli more than the self-deceiving view of God presented by Christianity, a view that Schopenhauer attacks particularly vigorously and mercilessly. To try to reconcile God's goodness and omnipotence with the suffering of the world and his prescience with the freedom of the will is an attempt to solve an equation which does not add up and is a piece of wretched logic.[126] Why Schopenhauer's criticism, more than anybody's, of the Judaeo-Christian view of life appealed to Pauli he explains in a letter to Aniela Jaffé.

> And then there is my feeling for *Schopenhauer*. I was always quite *aware* that his total identification of Christianity and Judaism was very agreeable, very *welcome* to me. In joining him in rejecting 'O.T.' and 'N.T.' (that should be the old *and* the new testaments; Schopenhauer's abbreviation) – as 'Jewish sabbatarian superstition' –

[122] Arthur Schopenhauer, *Parerga und Paralipomena II* (1851), (Leipzig, 1922), 179.
[123] Carl Friedrich von Weizsäcker, *Die Geschichte der Natur: Zwölf Vorlesungen* (Zürich, 1948).
[124] Pauli to Fierz, 17 Jul. 1948 [964], *PLC III*, 545.
[125] 'What has fascinated me in Schopenhauer was always his insistence on the reality of evil, from which also resulted his rejection of the ›theos‹ as ›Jewish‹ (actually Christian, Schopenhauer always treated them as identical) mythology.' Pauli to Fierz, 23 Oct. 1951 [1297], *PLC IV/1*.
[126] Schopenhauer, *The World as Will and Representation*, vol. I, 406–407, footnote 72, (§70).

> I was as it were 'well out of it', in other words outside any conflict between Judaism and Christianity. (Such appears indeed to Schopenhauer a kind of internal Jewish concern.)[127]

He harboured in his own cultural background a conflict between Christianity and Judaism – his father had converted to Catholicism and long concealed his Jewish identity from Pauli. Pauli was brought up in the Catholic tradition, which he left abruptly at the age of 29. Pauli therefore saw Schopenhauer's lumping together of Judaism and Christianity as one and the same mythology as a comfortable way of avoiding the whole conflict. Pauli describes this conflict as follows:

> To me it is all much more complicated than to you, both ancestry and religion. The former are both Jewish and Christian (among the Christian a rather decadent, now extinct Austrian noble family and also very healthy and robust Czechs). The Jewish forebears were for a long time in *Prague*, certainly a very characteristic city (I have always found Meyrink's 'Golem' quite fascinating), but one in which I have never been. My affinity for 'Mother Earth' is quite honestly *poor*. I was always totally cut off from the spiritual Jewish tradition. The Catholic religion, in which I was brought up, was not acceptable to me intellectually (even as a child), but was able to convey to me (regardless of its dogmas) what is a rite and what is a ceremony. [–––] So I have a Jewish heritage of psychic capabilities, together with a Catholic sense of ritual and ceremony, together with a definite opinion, *that the entire ideology of Judaeo-Christian monotheism is of no use to me*.[128]

Pauli had no time for an anthropomorphic concept of God, whether in a Christian or a Jewish version.[129] Pauli's attitude to Judaism changed for the better with time, however. He took a particular interest in the mystical tradition of Kabbalism and Hasidism. He considered generally that the mystical traditions had more in common with each other than their institutionalized variants, no matter whether they went under the name of Judaism, Christianity or Buddhism. There are two main reasons why Pauli saw 'the entire ideology of Judaeo-Christian monotheism as of no use'. First he had little patience with the unrealistic description of God as omnipotent, good and perfect, as it results in a tortuous circular argument and a splitting of hairs in order to explain away the evil and the suffering in the world. Here Pauli endorses Jung's criticism of *privatio boni* theology, which he dubs 'the hole theory of evil' (*Löchertheorie des Bösen*).[130] The other reason, linked to the first, is the mistake of attributing to God a pseudo-human consciousness.

[127] Pauli to Jaffé, 16 Nov. 1956,[2398],*PLC IV/3*.
[128] Pauli to Jaffé, 28 Nov. 1950 [1172], *PLC IV/1*.
[129] Pauli to Bohr, 3 Oct. 1950 [1158], *PLC IV/1*.
[130] Pauli to Fierz, 2 Jun. 1949 [1029], *PLC III*, 657.

The core of the absurd argument about the nature of God lay according to Pauli in the fact that God is credited with a consciousness, that God's being is anthropomorphized with such epithets as 'omniscient' and 'good'. However Pauli considered that the atheistic, God-denying position was as unsatisfactory as the 'anthropomorphic' one. He noted that as soon as 'the old God' (or, more correctly, the old image of God or perception of God) is declared dead, it is replaced by another concept that fulfils the same function. Schopenhauer's *will*, Nietzsche's *will to power*, Freud's *superego*, Aldous Huxley's *divine ground* and so on, are examples. What is typical of the modern 'image of God' is that it is not endowed with any pseudo-human consciousness but often bears the name of some all-explaining principle. Pauli considered it naive to believe that one had got rid of the idea of God by giving it a new name. It is in such cases better to realize its epistemological and psychological function and to watch out for where it insinuates itself in one's own view of the world.[131] Pauli later explicitly drew parallels between the works of Schopenhauer and Jung's and Bohr's ideas. Most clearly he expresses these in a letter to Marie-Louise von Franz: '›The world as will and representation‹ means nothing else to me than ›the world as a complementary pair of opposites‹ . . . '.[132] He especially emphasized the essay *Über die Grundlagen der Moral*, where Schopenhauer presents his views on the basis of ethics. He states there that ethics is based on the fact that all individuals are identical with one another on a deeper level of reality, a view that very much resembles Jung's concept of the collective unconscious (i.e. a common psychic layer for all of humanity).[133] Pauli also drew Jung's attention to Schopenhauer's essay *Über die ausreichende Absichtlichkeit im Schicksale des Einzelnen* – a text that he saw as a precursor to Jung's essay on Synchronicity.[134]

[131] Pauli to Fierz, 12 Aug. 1948 [971], ibid., 559. Cf. Jung, 'On the Nature of the Psyche', *C.W.*8, §359–60.

[132] Pauli to von Franz, New Year 1951/2 [1334], *PLC IV/1*.

[133] Pauli to Kröner, 27 July 1954 [1853], *PLC IV/2*.

[134] Arthur Schopenhauer, *Parerga und Paralipomena* I (1851), (Leipzig, 1922).

Ernst Mach and the Deconstruction of Language

'These people try to use the vagina as if it were a telescope to see the world through. But that is not its natural function – it is too narrow for that'.[135] These were the words of Ernst Mach on Freud's psychoanalysis According to Pauli this is an excellent illustration of Mach's instrumental way of thinking. To him the theory of psychoanalysis immediately conjures up the vividly concrete image of the wrongly applied instrument. There are few who can surpass Ernst Mach in terms of the influence he exerted on his contemporaries. Ernst Mach was born in 1838 in Moravia, then a part of the Habsburg Empire. He studied in Vienna and became professor of mathematics at Graz. In 1895 he was appointed to a chair in the theory and history of the inductive sciences in Vienna. His influence is evident among the young, creative artists of *fin de siècle* Vienna (known as the *Jung-Wien* movement), with prominent names such as Hugo von Hofmannsthal and Robert Musil. Mach's ideas also had an impact on the administration of justice, through the positivist legal philosophy applied by Hans Kelsen in the drafting of Austria's post-war constitution. Mach influenced the young Marxists in Austria, Switzerland and Russia, to the positivists of the Vienna Circle he was their leading light, and William James admired him and saw him as a kindred spirit. Finally yet importantly he had an influence on the development of modern physics: on several physicists, including Einstein and Pauli, he made a deep impression.[136]

The philosophy of Ernst Mach is regarded as positivism, but it differs quite sharply from the earlier positivism created by Auguste Comte. It is certainly true that in Mach we find the insistence that all knowledge must proceed from a description and methodical reproduction of facts provided by experience. But whereas Comte saw science as the highest stage of human development – a stage where man relies on observation and reason, Mach saw science as an extension of the instinct, whose aim is the satisfaction of practical and physical needs.[137] Mach considered, for example, that psychic phenomena, which do not fulfil a biological need, are pathological, a viewpoint which

[135] Pauli to Jung, 31 Mar. 1953 [60P], *PJL*, 104.

[136] Allan Janik & Stephen Toulmin, *Wittgenstein's Vienna* (London, 1973), 133.

[137] Ernst Mach, *Knowledge and Error: Sketches on the Psychology of Inquiry* (1905), (Boston, 1975), xxxi; 1–2.

seems to have influenced Freud. In a letter to his colleague Wilhelm Fliess, Freud also commented favourably on Mach's *Analyse der Empfindungen*, which he regarded as having exactly the same object as his own work.[138] Unfortunately Mach was less enamoured of Freud and his school.

Comte defined science primarily as a study of the laws of phenomena and as the establishing of connections between different individual phenomena. Mach on the other hand described science as man's innate tendency to organize and summarize experience in a purposeful manner. Thus Comte emphasized nature's own laws whereas Mach was interested in the laws of experience. While Comte was a sociologist and saw positivism as a tool for social reform with science as the catalyst, Mach was largely an epistemologist with a great interest in the tools of knowledge: perceptive apparatus and language. The earlier positivism in the spirit of Auguste Comte has more in common with the general Enlightenment philosophy of his contemporaries than with the positivism of Mach and the Vienna Circle.[139] Comte's positivism, with its emphasis on humanity, reason and progress, is infused with the same spirit as materialism, naturalism and scientism.[140] In its developmental perspective Comte's *Philosophie positive* resembles Marx's historical materialism, with its emphasis on human progress to higher and higher stages in conformity with certain historically determined laws.[141] In art and literature this spirit was represented by realism, which placed the stress on concrete existence rather than the imagined. In this sense Comte's positivism is akin to realism. If we are to identify the concept of positivism with Comte's positivism, the epistemological position taken by Einstein in his old age must also be designated positivist. For his battle cry against the Copenhagen School was: 'Physics is the description of reality as opposed to what one simply imagines!'[142]

Mach's firm insistence that all scientific statements had to be empirically verifiable led him to a very strict conceptual criticism. A concept had to be capable of being referred back to something truly observable. This attitude led him to reject such metaphysical hypotheses as the ether and absolute time and space. Mach's criticism of these concepts opened the way

[138] Freud to Wilhelm Fliess, 12 Jun. 1900. See John T. Blackmore, *Ernst Mach – His Work, Life and Influence* (Berkeley, 1972), 71.

[139] Auguste Comte, 'The Positive Philosophy' and 'A General View of Positivism', *Main Currents of Western Thought*, ed. Franklin L. Baumer (London, 1978), 524 ff.

[140] However it should be noted that Comte was not a materialist. August Comte, *Système de politique positive*, I (Paris, 1851), 50.

[141] These arguments are to be heard from others who may be regarded as belonging to the same epoch, including Herbert Spencer, Leopold von Ranke and Thomas Buckle.

[142] 'Physik ist die Beschreibung des Wirklichen', rather as opposed to 'Beschreibung dessen, was man sich bloss einbildet. (Einstein's words).' Pauli to Jung, 27 Feb. 1953 [58P], *PJL*, 92.

to Einstein's theory of relativity. Mach's position also made him sceptical of the introduction of atoms and molecules in physics. He regarded the laws of physics as purely descriptive: science explains nothing but deals solely with how phenomena behave. When it comes to a choice between two hypotheses which describe the same facts one should always choose the more economical one, in other words the one which does not use unnecessary and superfluous concepts.

Mach was not alone in his critique of language. Language comes under repeated attack during this period. In our context it is interesting to note that a major source of inspiration in this linguistic criticism was, apart from Ernst Mach, Søren Kierkegaard.[143] He criticized language mainly from an ethical point of view, especially the illusion-spreading language of the press. He wanted to use language as a tool for awakening. An illusion can never be tackled head-on; indirect methods have to be used. The indirect tools of language are satire, irony, comedy and allegory. With their aid it is possible to arouse people and to lead them to the threshold of knowledge, where they will be able to take the step across for themselves. This tool was called *indirect communication*. This inspired the young generation of Vienna to combine a critique of language with a critique of society.[144] An obvious representative of this critical attitude to the false and distorted worldview of the press was the Viennese newspaperman Karl Kraus. He did not mince his words in his attacks on the contemporary press: 'It turns ink into blood' in a time 'when pencils are dipped into blood, and swords into ink'. The impotence of language is so severe that the only thing an honest man can do is 'to step forward and be silent!'[145] Here it should just be added that Pauli always said that he refused to read newspapers (which was more of a 'statement' than the actual truth). He even claimed that newspapers are manifestations of the collective unconscious.[146]

Many young Marxists were attracted to Mach's philosophy specifically by the assertion that the laws of nature are economic summaries of human experience and not, as in Ockham, based on a metaphysical belief in the simplicity of the universe. To Mach the laws of nature are no longer objective forces driving the universe but summaries of human experience based on an economic principle. This economic principle expresses man's biological goal of doing things with the minimum possible energy loss. Science is thus linked

[143] Janik & Toulmin, 158 ff.
[144] Ibid, 87 ff.
[145] Karl Kraus, *Die Fackel,* 'In dieser großen Zeit', No. 404, 1914.
[146] Pauli to Jaffé, 1 Apr. 1953 [1546], *PLC VI/II*; Pauli to Fierz, 26 Aug. 1950 [1151], *PLC IV/1.*

with man and his activity. Young Marxists found a similarity between Mach's criticism of the absolute in the concept of time and space and Marx's criticism of the idealistic principles in economic theories. Historical materialism was however so firmly based on nineteenth-century 'concretism' that in the end it could not accept Mach's emphasis on human experience as the foundation of science. In consequence Lenin accused Mach of 'idealistic solipsism' because Mach made sensory impressions and not objective matter the basis of fact.[147]

Mach called his philosophical method *universal phenomenology* or elementism.[148] By that he meant that all empirical statements can be reduced to statements about sensory impressions, a position which is normally called phenomenalism. His criticism of the materialists was that they reduce reality to solid bodies and explain the rest of our sensory impressions, such as colour, scent and tone, as subjective. Even mathematics can, according to Mach, be traced back in the last resort to something sensory. He believed that the difference between the physical and the psychic depends only on the context in which one considers the phenomenon. Mach therefore saw introspective psychology as a legitimate field for study and also took an interest in dreams.[149] We get used to defining something as physical if it displays a physical regularity and we call it psychic if it displays a psychological regularity. Mach's analysis of visual symmetries has given rise to speculation concerning Mach as a forerunner of Gestalt psychology.[150] At bottom there is no difference in kind between the physical and the psychic with regard to their conformity to laws. According to Mach direct experience is *psychophysically neutral*. Psychology and physics deal with the same reality, even if they deal with it from different angles. Subject and object are not fundamental concepts but secondary mental constructions. To Mach this also means that what we call 'the ego' is merely an illusion, a viewpoint with a 'buddhistic' ring to it. He considered in actual fact that one of the chief merits of science lay in its reducing – even eradicating – man's sense of self and thus his self-centredness and egoism. Mach believed that the greatest achievement

[147] Lewis S. Feuer, *Einstein and the Generations of Science* (New York, 1974), 45–46.

[148] Blackmore, 121. Mach did not use the epithet positivism about his own method. Here the letter from Pauli to Jung about Mach's position has been wrongly transcribed. Pauli writes 'Mach gebrauchte diesen Terminus *nicht*' not 'Mach gebrauchte diesen Terminus *viel*' as is stated in *PJB* and has been translated into 'Mach used this term a great deal' in *PJL*. It should say 'Mach never used this term'. Pauli to Jung, 31 Mars 1953 [60P], *PJL*, 104. Cf *PJB*, 106. Compare *PLC IV/2* page 96 which has the correct version.

[149] Ernst Mach, *The Analysis of Sensations and the Relation of the Physical to the Psychical* (Chicago, 1914), 253 f.

[150] Blackmore, 47 f.

of science was in allowing man to be absorbed in the universe and thus be effaced.[151]

> The ego must be given up. It is partly the perception of this fact, partly the fear of it, that has given rise to the many extravagances of pessimism and optimism, and to numerous, religious, ascetic, and philosophical absurdities. In the long run we shall not be able to close our eyes to this simple truth, which is the immediate outcome of psychological analysis. We shall then no longer place so high a value upon the ego.[…] We shall then be willing to arrive at a freer and more enlightened view of life, which shall preclude the disregard of other egos and the overestimation of our own.[152]

What Mach takes as the given is not a conflict between consciousness and its objects but a continuous wholeness of qualities and sensory impressions. Colours, tones, scent, heat, cold, happiness, unhappiness and more are the elements of the world of our experience. They form more or less permanent complexes which we call 'things' and which we give various names. All these things are changeable, even if some characteristics are more constant than others. They are not sharply distinguished from their surroundings but form part of the vast continuum of reality. All sciences therefore have the same reality to work with and can use the same method.

Mach's positivism is already characterized by the distinctive spirit of the turn of the century and has more in common with this than with the positivism represented by Comte. It is therefore misleading, when talking about the turn of the century, to use the label 'the revolt against positivism', as so often happens in our historiography.[153] I regard it as more rewarding to see the turn of the century and the inter-war years as characterized by a *problematization of the position of man*.[154] Instead of branding the period with the pejorative attribute *subjectivism* I think that one may rather speak of a growing interest in, and a sharper focus on, *man*. The focus was on man as a cognitive creature, as a social, historical, instinctual and ethical being. Instead of having the world, matter and the spirit as the object of his interest, man makes himself the object, which naturally has the effect of problematizing the whole subject-object relationship. This spirit of the time was expressed in the need to recover the directly given, the genuine, the livable: that is to say *the direct experience*. This tendency is common to both positivism and the so-called anti-intellectual philosophies.

[151] Ernst Mach, *Popular Scientific Lectures*, (Chicago, 1910), 88.
[152] Idem, *The Analysis of Sensations*, 24–25.
[153] See, e.g., Hughes, 33 ff, and Baumer, *Modern European Thought*, 371.
[154] This is excellently done by, for example, Allan Janik and Stephen Toulmin in *Wittgenstein's Vienna*.

In the philosophy of Ernst Mach we recognize several aspects of the *fin de siècle* spirit discussed above:

- Mach's criticism of idealism and materialism as metaphysical devices of the intellect.
- The insistence on going back to the directly given, which to Mach means sensory impressions.
- The description of sensory impressions as a psychophysical flow that does not distinguish between subject and object, between internal and external experience.
- His view of science as an economic compilation of human experience, in other words an emphasis on science as a human construction.
- The linguistic criticism, where one of his goals is to show that many abstract concepts are pure inventions, which are falsely credited with a true existence (reification). These should be deconstructed by rigorous conceptual criticism.

This flowing, psychophysical view of the world stimulated new trends among the young artists of Vienna, principally impressionism. Inspired by Mach, Hugo von Hofmannsthal found the artistic picture the most dignified way of combining objective content and subjective experience. He also considered that the poet is nearer to reality for trying to express his sensations directly, without detours. The great task of the poet is moreover to create a unity between the ego and the world. In his twenty-fifth year he experienced a crisis concerning the loss of language. 'I have completely lost the ability to speak or to think of anything…' or 'I could present in sensible words as little as I could say anything precise about the inner movements of my intestines or a congestion of my blood'.[155] The language interested journalist Fritz Mauthner had read Schopenhauer and listened to Mach. He stated in resignation that 'language is only a convention, like a rule of a game: the more participants, the more compelling it will be. However, it is neither going to grasp nor alter the real world.' If one really has something to say, one is forced to be silent.[156] Language is regarded as a fiction that is used *as if* it were true.[157] Language is primarily a social pattern of action, or a mirror of the social structure in which the relationship between concepts is more important than their content.[158]

[155] Allan Janik and Stephen Toulmin in *Wittgenstein's Vienna*, 114–15.

[156] Quoted in Janik & Toulmin, 126.

[157] Hans Vaihinger, *The Philosophy of 'As-If'* (published in 1911, but presented as a dissertation in 1877).

[158] Ferdinand de Saussure considered that language should not be seen diachronically (historically),

The young Viennese Ludwig Wittgenstein had read Mauthner's work but could not accept his total scepticism. Wittgenstein attempted by means of a rigorous 'critique of language' to establish the limits within which language could actually represent reality. Inspired by Gottlob Frege, Heinrich Hertz and Bertrand Russell, he wanted to see language as a mathematical structure made up of elementary propositions concerning facts, which are entirely regulated by the internal logical structure of the proposition. By this means Wittgenstein thought that he could demonstrate the nature and limitations of language from within the language structure itself, instead of criticizing it from the outside with the aid of a theory *about* language. Just as we can depict a person in an artistic representation, so we use language to construct propositions concerning reality, which have the same form as the facts they picture. These representations are not exact reproductions of the facts, but a verbal representation of the essential in them: objects designated by names and the logical relationship between them. Behind the diversity of everyday language and of reality there is assumed to exist a common logical structure or a logical skeleton that always makes it possible to compare our model or representation of reality with reality's own structures. So we make models of facts that are laid against reality as a measure. There is sufficient structural similarity (isomorphism) between language and reality to enable language to be used in its descriptive function. Facts are therefore always a construction, a representation of the objects and their logical relationships. By analysing language in this manner Wittgenstein could show the intrinsic limits of the linguistic system. Language is the representation of the world, its mirror. It can depict the world and therefore make scientific knowledge of the phenomena possible, but it can do no more. It can construct a model of reality but it can never say anything about the nature of this reality or about the relationship between the model and reality, without becoming self-referring and therefore meaningless.

Wittgenstein distinguished between what can be said and what can be shown. The model can bear a relation to reality, but this relation can never be formulated logically. He was inspired here by the argumentation of Hertz and Boltzmann in mathematics: one and the same quantity of facts can be described with the aid of mutually incompatible models which supplement each other. They had also stated that no axiomatic system can itself say anything about reality. The relationship between a language and reality cannot be examined by use of language. It would be like trying to climb up a ladder while trying to hold it steady oneself. In physics one can discuss the relation-

but synchronically, as a system of phonetic and semantic oppositions. He distinguished between the application (*parole*) of language and its underlying system of rules (*langue*).

ship between a physical model and the phenomena it seeks to describe by using a language different from that of the theory concerned. Where language as a whole is concerned, however, we have no Archimedean point, no extra-linguistic language, by means of which we can carry out a critical analysis. We will see that this is exactly the problem that engaged Niels Bohr and which he illustrated with his famous example of the cane.

With a rigorous critique of language and logic Wittgenstein finally arrived at the uttermost boundary of the rational: the problem of self-reference. Wittgenstein considered that the fully analysed language is a closed entity where all that is necessary is revealed. The model of reality cannot represent anything that is not based on fact. Language can never express anything more than the factual and therefore it cannot express anything that is 'higher'.[159] On this, silence must be maintained. Language can never express what is really essential in life: ethics and meaning. Such things can only be shown by indirect or poetic communication. There is no value in facts, so the meaning of the world must lie outside the world and outside of logic. Consequently it is not the illogical pronouncements that are meaningless, as the Vienna positivists would have it, but the logical. *Logik ist sinnlos und Philosophie Unsinn* /Logic is futile and philosophy nonsense/. This nonsense was by no means without importance to Wittgenstein. The important point is that language has both functions: representing reality by means of what is said and conveying a meaning by means of what is shown. Language is therefore a paradox. The aim of Wittgenstein's work was to distinguish between these two functions of language, so that they should not be confused. What can be said logically with the aid of language contains its own limits and therefore it is impossible to construct a fully rational model on which science can rest. The link between the statements and the reality *shows itself*, the relationship between language and the world is inexpressible – it is *irrational*.[160]

> My propositions are elucidatory in this way: he who understands me finally recognizes them as senseless, when he has climbed out through them, on them, over them. (He must so to speak throw away the ladder, after he has climbed up on it.)
>
> He must surmount these propositions; then he sees the world rightly.
>
> Whereof one cannot speak, thereof one must be silent.[161]

Wittgenstein's ideas inspired the founders of neopositivism in Vienna and of analytic philosophy in England. Both sprang up in opposition to the old

[159] Janik & Toulmin, 197 f.

[160] Ibid., 198–199.

[161] Ludwig Wittgenstein, *Tractatus logico-philosophicus* (1921), proposition 6. 54–7, (London, 1951), 189.

metaphysics or academic philosophy represented by idealism and realism. They were looking to find firm new ground for knowledge, with the exact sciences, particularly logic and mathematics, as a model. The logical positivism that grew up in Vienna sought to supplement and perfect the positivism of Ernst Mach, the pragmatism of William James and the conventionalism of Henri Poincaré by adding the logical element borrowed from Gottlob Frege, David Hilbert, Bertrand Russell and Ludwig Wittgenstein.[162] Moritz Schlick is generally regarded as the founder of the Vienna Circle; other familiar names are Hans Reichenbach, Philipp Frank, Otto Neurath, Edgar Zilsel and Rudolf Carnap.

The logical positivists belonged to the iconoclastic spirit of the age in the sense that they saw it as their task to demolish the structures of dogmatic academic philosophy and clear away the obscure in order to bring out the meaningful. Thus they wanted to build up a strong anti-metaphysical philosophy, whose purpose was to clarify scientific concepts and methods. Philosophy should not be a doctrine but an activity, which is constantly examining and analysing the process of conceptualization. In this way philosophy would be synonymous with theory of science and epistemology. The logical positivists reasoned as follows: what idealism and realism have in common is that they concern themselves with questions of whether external 'reality' exists and whether or not in that case we can know anything about its 'true nature'. The realist answers 'yes' to these questions whereas the idealist answers 'no'. But both consider the questions relevant. This antiquated question of what the world 'really consists of' leads only to interminable meaningless problems that cannot be solved. The critical attitudes of Mach and James were therefore a great step forward in the development of science. They had realized that all references to a reality beyond the phenomena are metaphysics. As metaphysical questions are unanswerable, they are also meaningless. There was appreciation for William James' pragmatic view of science: a physical theory is an aid in finding our way in our experiential world; it is not a reconstruction of reality. The only essential requirement of a theory is that it functions and that it should be useful to us. By a 'functioning theory' James meant a theory that can mediate between all earlier truths and new experiences. He also endorsed Mach's demand for the unity of all sciences, i.e. that all sciences should apply the same scientific method. In Poincaré it was first and foremost the 'conventionalist' perspective that appealed to the Vienna philosophers. The conventionalism of Poincaré implies that the geometric axioms cannot be

[162] Philipp Frank, 'Was bedeuten die gegenwärtigen physikalischen Theorien für die allgemeine Erkenntnistheorie?', *Erkenntnis* 1 (1930), 135–137.

traced back either to synthetic a priori truths or to empirical knowledge, but are conventions which we choose because they are simple and can describe our everyday experience.

However Mach, James and Poincaré had overlooked the importance of formal logic in the development of human experience. In contrast to Mach, they took the logician's approach to mathematics and expressed views similar to those of Frege, Hilbert and Russell on this issue, considering mathematics similar in nature to logic and therefore not reducible to experience. Mathematics and logic are tautological systems of rules, true or false propositions are exclusively determined by the rules of combination of symbols and have nothing to do with reality. The truth-value is directly dependent on the method of verification. The logical positivists therefore categorized all knowledge as either analytic, a priori knowledge or synthetic, a posteriori knowledge. No essential knowledge can be both synthetic and a priori. If a concept cannot be placed in either of these categories – observation or logic – then it is meaningless. This means by extension that all value-judgements, ethical or aesthetic, are meaningless. Thus the logical positivists succeeded in somehow turning upside down Wittgenstein's intention of separating the scientific sphere from the ethical. Wittgenstein's intention had been to show the relatively limited area within which language and logic fulfil their functions. He did this for the purpose of distinguishing it from the rest of the real values of life. His work was a kind of exorcism, in which the lesson was the humility before all that we cannot capture in words.

What Wittgenstein had begun to suspect in philosophy was completed by Kurt Gödel in mathematics. This is not altogether surprising, as Wittgenstein had himself drawn inspiration from this field. Mathematicians had long been trying to free themselves of the antinomies or paradoxes which they had encountered in set theory, especially developed by 'the Kant of mathematics', Georg Cantor. These paradoxes split the mathematicians into two main camps: the formalists and the logicians. We have already mentioned the latter's approach to mathematics represented by Russell and Whitehead and their attempt to reduce mathematics to symbolic logic. The formalists, represented by David Hilbert and Giuseppe Peano, wanted to preserve Cantor's theory by presenting mathematics as a formal axiomatic system on the lines of geometry. In 1931 Kurt Gödel published his work *Über formal unentscheidbare Sätze der Principia Mathematica und verwandter Systeme I*, where he proved that both approaches were impossible. Kurt Gödel, also (like Mach and Freud) a famous child of the province of Moravia in the Austro-Hungarian empire, had been a member of the Vienna Circle, although he never believed

in the possibility of reducing mathematics to logic. Here Gödel stated that the very wish to use arithmetic to show that arithmetic is consistent and complete is itself an antinomy, in other words a self-reference. To carry out such a project arithmetic had to make metamathematical statements that go beyond its proper sphere of application. By rigorous mathematical analysis Gödel showed that all such attempts to make a system free from contradiction and at the same time complete by using the system itself were logically doomed to fail. Gödel showed in consequence with the aid of mathematics that every axiomatic system contains statements that – together with their negation – are non-determinable within their own system. By means of a metamathematical language, i.e. by means that are outside the given formal system, however, it is very possible to show that these statements are true. But the implication of this is that the system of axioms is incomplete, as it has to refer to something outside itself. To Gödel incompleteness of proof showed that every logical and axiomatic system contains essentially undecidable propositions, and hence is fundamentally incomplete. The result is that an axiomatic system can only be free from contradiction if it is incomplete, and only complete if it contains undecidable statements. What Gödel did was nothing less than to put an end to one of the oldest ambitions of science: to find a complete *and* consistent system for describing the world.

With this one may say that the work of both Wittgenstein and Gödel implied a deconstruction of logic from within. In that sense they both shared that *fin de siècle* mentality which broke down the old structures and ways of thinking. However it must be remembered that this was never their intention. It had rather been the opposite: to find a firm foundation consistent with the laws of logic, on which a scientific view of the world could be built. In their quest for this and with the aid of the most refined instruments of science, they wiped out the very preconditions for such a foundation.[163] This is also the central theme of the physics and philosophy of the Copenhagen school, so nicely summarized by Niels Bohr's oft-repeated quotation from Schiller's poem *Spruch des Konfuzius*: 'The full mind alone is the clear, and truth dwells in the deeps'.[164] Hertz, Wittgenstein and Gödel had established that a fully rational language or a closed logical system can tell us only about itself. The same insight is in a way expressed by the developing sciences of anthropology and ethnology: we are captives in our own cultural structures and we should not imagine that we can quite simply observe and understand another

[163] Wilhelm Just, 'Schatten und Ganzheit', *Der Pauli-Jung Dialog*, 191 f; Herman Weyl, *Philosophy of Mathematics and Natural Science* (Princeton, 1949), 219–20.

[164] Heisenberg, *Physics and Beyond*, 209.

culture.[165] Bohr, too, drew this parallel when he said that the principle of complementarity can help us to understand that every contact with a foreign culture also involves an intervention in it, while at the same time the observer cannot remain an unaffected and independent watcher, but must expect to have his view of the world altered.[166]

One of the consequences of the wish to study the phenomena in their own right without reducing them to the finished templates of either idealism or materialism was that Western man began to question his own position in a larger and more uncertain world. Man sought to rediscover a 'true' starting point and firm ground to stand on, now that all the old values and principles were rocking. Some sought this ground by turning their backs on science in order to rediscover the irrational and emotional values of life. Others looked for the foundation in a new view of science that would define the territories of both science and values to the benefit of both. They turned away from 'objects' and 'substances', away from spirit and matter. Instead they looked for what they saw as the directly given: the genuine experience and the possibility of communicating it. Concepts such as 'experience', 'perception', 'authenticity', 'communication' and 'symbol' become fundamental. The anti-scientists associated these concepts with 'feeling', 'life', 'intuition' and 'art', while the scientific defined them as 'experience of the senses', 'observation', 'fact' and 'logic'.[167] In linguistic criticism we see how a reliable old tool comes to be regarded as inadequate and constricting.[168] The turn of the century is a time when language and communication become a problem in every area. Later we see the same problems recur in the crisis of quantum physics, particularly during the years 1918–27, when the physicists in the circle of Niels Bohr struggled with questions concerning the use and clarity of our everyday language in physics.

[165] For example Franz Boas, Bronislaw Malinowski, Ruth Benedict and Margaret Mead.

[166] Niels Bohr, 'Natural Philosophy and Human Cultures' (1938), *Atomic Physics and Human Knowledge*, 29–30.

[167] Heinrich Rickert, *Die Philosophie des Lebens: Darstellung und Kritik der philosophischen Modeströmungen unserer Zeit* (Tübingen, 1920), 4.

[168] Rainer Maria Rilke, Robert Musil, Franz Kafka, Hugo von Hofmannsthal.

Niels Bohr and the Copenhagen School

In modern science the period 1900–1928 has been designated the time of *the crisis in physics*. During this period there is an explosive development in the discipline that turns some of the firmly established truths of classical physics on their heads. As physics has functioned as a model and a foundation stone in our scientific thinking a 'crisis' in physics has repercussions on science as a whole and enlivens the great and eternal questions of philosophy. In physics these questions found one original solution in the Copenhagen School's interpretation of quantum physics, which implied an entirely new epistemological orientation and new criteria of science.

The Copenhagen School emerged with the Danish physicist Niels Bohr (1885–1962) as a central figure. He had been working since 1914 to establish his own institute of theoretical physics, a dream that was realised in 1921. When it comes to understanding the history of quantum physics it is impossible to exaggerate the role of Niels Bohr, especially where his contribution as originator of a stimulating scientific environment is concerned. His genius was one of combining practical skills with a strong social or 'dialogical' stance. His practical skills included such things as the detail planning of the institute building – he had a hand in everything from the blackboards to the vacuum pumps, but also his ability to raise funds for the institute as well as for his colleagues. The social side can best be described as his liking for a person-to-person dialogue and his disregard for the conventional separation of the professional and personal domains: he loved to take his colleagues and students for long walks in the park surrounding the institute, or to his summerhouse in Tilsvilde, on hiking tours etc. 'to really get to know them'.[169] This personal atmosphere was intensified by the fact that Bohr and his family had their living quarters at first on the top floor of the institute, and later in a separate building next door called the 'Villa'. Students and assistants usually lived in the guest apartment in the main building, but sometimes they were also invited to stay in Bohr's home, which became a second centre for intellectual exchange.[170] Bohr might at any time come knocking at the door to

[169] Pais, Abraham, *Niels Bohr's Times, in Physics, Philosophy, and Polity* (Oxford, 1991), 263.

[170] 'Bohr's influence on his immediate surroundings was in no way restricted to the private discussions and the Colloquia; it was rather that Bohr's private apartment constituted a second centre,

discuss a scientific or philosophical problem. Bohr's personality is described as kind, introverted, generous and humble, as well as self-confident and extremely insistent, almost fanatical.[171] There are several examples of how Bohr drove his colleagues to exhaustion and even to tears while discussing scientific and philosophical issues. The best-known are his confrontations with Schrödinger in 1926 and with Heisenberg in the spring of 1927. Both concerned the wave or particle interpretation of quantum physics.[172]

The characteristic atmosphere at the 'Institut før teoretisk fysik' or the Niels Bohr Institute was this fluidity of the boundaries between the private and the professional, work and leisure, science and philosophy. It was a place for 'intellectual stimulation and help in advancing careers, spiritual fulfilment and down-to-earth fun, material benefits and psychological counsel'.[173] How strongly Bohr's institute influenced the lives of his students is shown by the fact that many of them learned to speak and write Danish, and many of them found Danish girl friends and wives.[174] All this became known as 'the Copenhagen spirit'. Holidays were often used for collaboration and conferences, so that young scientists tied up elsewhere could come together to discuss the latest theories. Bohr was also willing to raise the money for those who could not afford the trip. He was especially keen on inviting young scientists because, as he stated in his inauguration speech for the institute, only young people can see things from a new perspective and so contribute fresh ideas.[175]

Immediately after the First World War Bohr showed his disregard for convention and his liking for dialogue when he felt disinclined to observe the international cultural and scientific boycott of German scientists. Coming from a neutral country, he felt free to accept invitations to Germany, and in his turn to invite scientists from everywhere, Germany included.[176] This led amongst other things to the arrangement of the so-called 'Bohr-festspiele' in

where most of Bohr's own work was produced, and to which came a flood of visitors of the most different persuasions. Apart from students and short-term visiting physicists there were colleagues of different disciplines, high Danish officials, artists, politicians etc. Even the Danish royal family came on many occasions. These talks and discussions in the home of the Bohr family were not at all restricted to physics and natural science: they covered philosophy, history, art, history of religion, ethics, politics, world events and other issues.' James Franck, 'Niels Bohr's Persönlichkeit', *Niels-Bohr 1885–1962: Der Kopenhagener Geist in der Physik*, eds. Karl von Meyenn, Roman U. Sexl & Klaus Stolzenburg (Wiesbaden, 1985), 15.

[171] Pais, Abraham, *Niels Bohr's Times, in Physics, Philosophy, and Polity* (Oxford, 1991), 135.

[172] Heisenberg, *Physics and Beyond*,

[173] Beller, 270.

[174] Pais, Abraham, *Niels Bohr's Times, in Physics, Philosophy, and Polity* (Oxford, 1991).

[175] Bohr, Niels, 'Ansprache bei der Einweihung des Instituts für Theoretische Physik am 3. März 1921' in *Niels Bohr 1885–1962: Der Kopenhagener Geist in der Physik* (Braunschweig, 1985), 290.

[176] Karl von Meyenn & Klaus Stolzenburg, 'Einführung' in Niels Bohr 1885–1962: *Der Kopenhagener Geist in der Physik* (Braunschweig, 1985), 27.

Göttingen 1922 where for the first time he met Sommerfeld's two top students, Wolfgang Pauli and Werner Heisenberg. He immediately invited both of them to spend time at the Copenhagen institute. Bohr became to Pauli, as to many other young physicists, a father figure and a great influence. He describes the strength of Bohr's attitude as one of bringing opposites together: he integrated 'the diverse scientific standpoints and epistemological attitudes of the physicists, and thereby imparted [. . .] the feeling of belonging, in spite of all their dissensions, to one large family'.[177]

Quantum Theory and the Spirit of the Age

Many attempts have been made to characterize and analyse the philosophical and epistemological position of the Copenhagen School and especially of Bohr, and its significance in the emergence of the definitive interpretation of quantum mechanics. The usual approach is to contrast the point of view of Bohr and the Copenhagen School with that of Einstein and other critics. In some accounts the interpretation of the Copenhagen School is identified with Bohr's philosophy and Bohr's colleagues are regarded as 'disciples', who more or less endorsed his 'doctrine'.[178] In sharp contrast, others assert that the so-called Copenhagen School interpretation is not at all that of Bohr or of anyone else, but a compromise which obscures the real philosophical differences between the various physicists in Bohr's circle. In their opinion the Copenhagen School interpretation is in actual fact directly contrary to the views of the individual physicists.[179]

My research has led me to agree with the view that the Copenhagen School did not consist of a uniform philosophical viewpoint but was rather a combination of, or a compromise between, a number of different viewpoints. It therefore becomes important to make a distinction between the views of Bohr and those embraced by fellow-creators of the quantum theory in his circle, such as Wolfgang Pauli, Werner Heisenberg, Oskar Klein, Max Born, Pascual Jordan, H.A. Kramers, Léon Rosenfeld and others, but also to try to define the points of agreement. Analyses seeking to define the typical traits of the Copenhagen School have produced many different conclusions, of which two seem especially contradictory: that the Copenhagen School represents

[177] Wolfgang Pauli, 'Niels Bohr on His 60th Birthday' (1945), *Writings on Physics and Philosophy*, 51.

[178] E.g. John Heilbron, 'The Earliest Missionaries of the Copenhagen Spirit', *Revue D'histoire des Sciences* 38 (1985), 195–230.

[179] Hendry, *The Creation of Quantum Mechanics*, 129; Paul Feyerabend, *Realism, Rationalism and Scientific Method*, Philosophical Papers 1 (Cambridge, 1981), 247–248, Mara Beller, *Quantum Dialogue: The Making of a Revolution* (Chicago, 1999).

the result of applied instrumental positivism on the one hand, and that it stands for a kind of anti-intellectualism or mysticism on the other.[180]

Some historians of science, noting the cultural environment of the pioneers of quantum physics, claim that these physicists had a strong philosophical preference for indeterminism.[181] Paul Forman argues that German physicists and mathematicians were under social and intellectual pressure from the particular anti-intellectual spirit of the Weimar culture, which made them anxious to adopt or at least to emphasize those parts of science that could play up to the cravings of the public. This spirit, as exemplified by Spengler's book *The Decline of the West*, accommodated anti-determinism, acausality, existentialism, vitalism, Husserl's phenomenology, holism, Gestalt psychology, mathematical intuitionism and also an interest in Pythagorean numerology, alchemy and kabbalism.[182] Forman argues that a non-scientific factor – a philosophical attitude, a social or intellectual environment – precedes science itself and 'causes' the form it takes.[183] The opposite view is

[180] Bohr and the Copenhagen School as positivists, logical empiricists, anti-realists, subjectivists: Patrick A. Heelan, *Quantum Mechanics and Objectivity: A Study of the Physical Philosophy of Werner Heisenberg* (The Hague, 1965), ix, 132; Mario Bunge, 'The Turn of the Tide', Karl Popper, 'Quantum Mechanics Without the Observer' both in *Quantum Theory and Reality*, ed. Mario Bunge (New York, 1967), 1–44; Ingemar Nordin, 'Niels Bohr som vetenskapsfilosof', *Att förstå världen*, ed. Stellan Welin (Gothenburg, 1984), 97–107. Bohr and the link between the new physics, mysticism and 'anti-intellectualism': *Quantum Questions*, ed. Ken Wilber (London, 1984), ix-x; Fritjof Capra, *The Tao of Physics* (London, 1976); idem, The Turning Point (London, 1982), 66; Gary Zukaw, *The Dancing Wu Li Masters* (London, 1980); Tor Nørretranders, *Det udelelige - Niels Bohrs aktualitet i fysik, mystik og politik* (Copenhagen, 1985), 222 ff; John Honner, *The Description of Nature: Niels Bohr and the Philosophy of Quantum Physics* (Oxford, 1987), 177–193. Paul Forman, 'Weimar Culture, Causality, and Quantum Theory, 1918–27: Adaptation by German Physicists and Mathematicians to a Hostile Intellectual Environment', *Hist. Studies Phys. Sci.* 3 (1971), 45–46. Mara Beller claims that this apparent contradiction only arises because scholars are seeking a coherent philosophical standpoint in the Copenhagen interpretation. The problem disappears when one realizes that 'the inconsistencies are genuine', based on the defects of Bohr's thinking, combined with the sad circumstance that nobody in his circle dared to criticize him, and moreover that the 'philosophy' was only an instrument to gain hegemony as the only true version of quantum physics. Beller, 270 ff., 275.

[181] Max Jammer, *The Conceptual Development of Quantum Mechanics* (New York, 1966), Jan Faye, *Niels Bohr: His Heritage and Legacy* (Dordrecht, 1991); Paul Forman, 'Weimar Culture, Causality, and Quantum Theory, 1918–27: Adaptation by German Physicists and Mathematicians to a Hostile Intellectual Environment', *Hist. Studies Phys. Sci.* 3 (1971), 45–46; Holton, Gerald, 'Roots of Complementarity', *Thematic Origins of Scientific Thought* (Cambridge, 1973); John Heilbron, 'The Earliest Missionaries of the Copenhagen Spirit', *Revue D'histoire des Sciences* 38 (1985), 195–230; Krips, H., 'Quantum Mechanics and the Post-Modern in One Country.' *Cultural Studies* 10, 1 (1996) 78–114; Wise, N.J. 'How Do Sums Count? On the Cultural Origin of Statistical Causality' in L. Krüger, G. Gingerenzer, M.S. Morgan, *The Probabilisitc Revolution*, Vols.1 and 2, (Cambridge, 1987).

[182] Forman, 7, 74–108;

[183] Forman insists at several points in his essay that as a historian of science one must be able to demonstrate a causal connection between the 'intellectual currents' of an epoch and the circumstances that cause scientists to be carried along by them. 'For it seems to me that the historian cannot rest content with vague and equivocal expressions like ›prepared the intellectual climate for‹ or ›prepared, so to speak, the philosophical background for‹, but must insist upon a causal analysis, showing the circumstances under which, and the interactions through which, scientific men are swept up by intellectual currents.' Ibid., 3.

taken by those who believe that the emergence and shape of quantum physics were the result only of compelling empirical facts and that any philosophy is a direct result of these.[184] Another position is that the philosophy of physics is an entirely dispensable part of physics; the only thing that matters is the development and efficiency of new scientific tools, which have nothing to do with philosophy. Philosophy is only employed for the dissemination and consumption of the final scientific theory.[185] I find all of these standpoints too simple. Of course one can use the same scientific tools without sharing the same philosophy, but one can also disagree on what tools to use based on philosophical grounds.[186] Philosophy can play a part at any level: sometimes it is directly linked to scientific discovery, or to a definite line of research, and sometimes mainly to extra-scientific factors such as social, cultural environment or private, religious taste. It develops or changes over time and need not be coherent (not even the philosophical products of 'real' philosophers are always contradiction-free). Therefore we need to approach this issue with care. To show that there exist philosophical influences on a physicist is relatively easy, but to evaluate the role of these influences on his or her scientific work is much more difficult.[187]

A good example of the complexity of philosophical standpoints is the relationship between positivism and so called anti-intellectualism, two appar-

[184] Henry Folse, *The Philosophy of Niels Bohr* (New York, 1985), 21.

[185] Beller, 319.

[186] Some experimental physicists criticized Einstein's theories because he relied too much on mathematical formalism and too little on observation. See C.O. Stawström, 'Relative Acceptance: The Introduction and Reception of Einstein's Theories in Sweden, 1905–1965' in *Centre on the Periphery: Historical Aspects of 20th Century Swedish Physics,* ed. Svante Lindquist, Science History Publications, 1993, 293 ff.

[187] Beller makes a distinction between a philosophical influence and access to philosophical resources. The exact nature of this distinction is not clear, but the first seems to be closer to what she calls philosophical commitment, a philosophical stand that really moulds the way one looks at the world, while the second seems much freer and lets one make use of different philosophical perspectives as it suits one for the moment. Moreover she states that a scientist has a very instrumental relationship to philosophy, he or she is 'committed' only as long as it helps to solve scientific problems. The matter is further complicated by adding the concepts of temperament and taste as crucial factors in the choice of a perspective. Finally it is only in old age that scientists develop a 'preferred philosophical position', and then only as a way of exalting their successful theories to the status of philosophy and 'message'. Beller, 58, 189. There are many examples that speak against such a view. Many scientists 'believed' for example in indeterminism because they saw in it an argument in favour of free will. See e.g. Hermann Weyl, 'Das Verhältnis der kausalen zur statistischen Betrachtungsweise in der Physik' (1920), Ges. Abhl., 2, 113–122, C.W. Oseen, *Frågan om viljans frihet, betraktad från naturvetenskaplig synpunkt*, Heimdals småskrifter nr. 6 (Uppsala, 1909), 3–23 and 'Determinism och indeterminism', *Religion och Kultur* 1 (1930), 143; Oskar Klein to Cassirer, 1937, *Niels Bohr Archive*, Niels Bohr Institute, Copenhagen; see also Suzanne Gieser, 'Philosophy and Modern Physics in Sweden: C.W. Oseen, Oskar Klein and the Intellectual Traditions of Uppsala and Lund, 1920–40' in *Centre on the Periphery: Historical Aspects of 20th century Swedish Physics,* ed. Svante Lindquist, Science History Publications, 1993, 24–41.

ently opposed positions. According to Forman the rejection of positivism is linked with the preference for an indeterministic and acausal worldview, a position that equals anti-intellectualism. However it is not possible to demonstrate an unambiguous link between a dismissive attitude to the positivist scientific ideal and a preference for an acausal worldview. Max Planck had introduced the quantum, and with it acausality, into physics. Despite this he remained a believer in causality all his life and also rejected positivism.[188] Pascual Jordan, on the other hand, embraced positivism whole-heartedly and even saw it as a prerequisite of the new, open acausal worldview.[189] Sommerfeld rejected the positivist ideal of science and also dispensed with causality, although he was not at all pleased with the 'uncertainty' of modern physics. Just like Einstein, he longed for a uniform view of the universe. The difference between him and Einstein was that Sommerfeld felt obliged to accept the viewpoints of modern physics, which Einstein was never willing to do. In 1930 Sommerfeld writes to the Swedish physicist C.W. Oseen as follows:

> I am not very happy with 'vague physics', especially when young enthusiasts or formalists talk about it in the department for hours, although I must acknowledge the legitimacy of the whole way of looking at it. But perhaps it can still be overcome by some 'metaphysics' (all physics is metaphysics according to Einstein). How inelegant, for example, the general theory of relativity would become, if one were to take into account the precision of measurement there too![190]

Sommerfeld's interest in numerical harmony and Pythagorean numerology had, according to himself, nothing to do with the kind of 'mysticism' which engages in spiritism and astrology.[191] We find the same distinction between different kinds of 'mysticism' or 'religion' in many representatives of modern physics: in Niels Bohr, Oskar Klein, Wolfgang Pauli, Werner Heisenberg and Albert Einstein, to mention a few.[192]

In Forman's argument the crisis of physics was something that the physicists themselves were looking for in order to adjust to the anti-intellectual spirit in Weimar Germany. All the discussions of the 'crisis' of science, causal-

[188] John Heilbron, *The Dilemmas of an Upright Man: Max Planck as Spokesman for German Science* (Berkeley, 1986), 47 ff.

[189] Pascual Jordan, 'Positivistische Bemerkungen über die Parapsychischen Erscheinungen', *Zentralblatt für Psychotherapie* IX (1936).

[190] Sommerfeld to Oseen, 22 February 1930, Ms Oseen, *Archives of the Royal Swedish Academy of Sciences*, Centre for History of Science, Stockholm.

[191] Arnold Sommerfeld, 'Die Bedeutung der Röntgenstrahlen für die heutige Physik' (1925), *Gesammelte Schriften*, IV (Braunschweig, 1968), 575.

[192] Niels Bohr, 'Biology and Atomic Physics' (1937), *Atomic Physics and Human Knowledge*, 20; Oskar Klein, *Orsak och verkan i den nya atomteoriens belysning* (Stockholm, 1935), 94–95; Wolfgang Pauli, 'Science and Western Thought' (1955), *Writings on Physics and Philosophy*, 137; Albert Einstein, 'Religion und Wissenschaft' in *Mein Weltbild* (Berlin, 1955), 15.

ity and the classical worldview in the period 1918–1925, i. e. before the formulation of Heisenberg's matrix mechanics and Schrödinger's wave mechanics, must have been prompted by a yearning for a crisis in general.[193]

Beller argues something similar when she states that the physicists behind the Copenhagen interpretation chose to emphasize acausality and indeterminism, not on a scientific basis, but purely as an ambitious way to power, although she in contrast to Forman argues that before 1925 none of the physicists involved in the Copenhagen interpretation emphasized acausality, indeterminism and the like. On the contrary they preferred to emphasize the connection between the new quantum theory and the past classical ideas. The emphasis on acausality and 'revolution' in physics only emerged after 1925 and as a direct response to Schrödinger and Einstein's challenge to the Göttingen-Copenhagen version. This rhetoric of acausality was fuelled by envy and fear that Schrödinger's or Einstein's solution would 'win' and so they constructed a 'shift in paradigm' where they described their own acausal version as 'new' and 'revolutionary' while Einstein and Schrödinger were 'conservatives'. They simply had to dispose of the old (i. e. classical physics) in order to discredit the opposition.[194] Beller's version supports Forman's thesis that the physicists 'played up' to an audience that 'wanted' to hear about 'revolutions' and 'crises'. How else could this calculating strategy of Bohr et al have succeeded?

In stark contrast to this partisan view stands Pauli's recollection of a 'tremendous shock' dealt to him and the physicists of both his generation and the previous one when the new situation in physics became clear to them. It was not acausality per se that was seen as the great novelty but the unexpected link between energy and frequency that the introduction of Planck's constant (the quantum postulate) in 1900 revealed. Discontinuities and primary probabilities were the consequences of this postulate, which later came to be seen as the event that started off the 'crises in physics'.[195] Certainly the First World War aggravated the significance of the disintegration of the classical worldview and of classical physics, as the general feeling of destruction and crisis was evident in so many fields. The fact that some of the philosophers and physicists of Weimar Germany in their turn made use of the situation in science to fuel their arguments that the mechanical,

[193] Forman focuses on Arnold Sommerfeld, Herman Weyl, Richard von Mises, Franz Exner, Walther Nernst, Walter Schottky, Erwin Schrödinger, Hans Reichenbach.

[194] Beller, 279 ff.

[195] 'I still vividly recall the tremendous shock dealt to me as a student by this state of affairs and its implications. Most of the physicists of my generation and the previous one reacted in the same way.' Wolfgang Pauli, 'Modern Examples of ›Background Physics‹', (June 1948), [Appendix 3], *PJL*, 183.

determinist era was at an end should be seen not as an 'adaptation' to the spirit of the time but rather as an expression of it.

Niels Bohr's Philosophical Background

Many attempts have also been made to analyse Bohr's sources of philosophical inspiration. There is a generally held view that it is difficult to get to grips with Bohr's philosophy, not least because he is not always the most lucid of writers. Almost all analyses of Bohr's philosophy emphasize the importance of the influence of the Danish philosophers Harald Høffding, Søren Kierkegaard and Poul Martin Møller. Another central figure is the American psychologist William James. Commentators differ in their view of the relative importance of these thinkers to Bohr. Lewis Feuer sees Kierkegaard as the predominant influence.[196] As Høffding was a great interpreter of Kierkegaard and Henri Bergson in Scandinavia, however, and also a great admirer of William James and Ernst Mach, many would say that Høffding was the single most important influence. They see it as probable that Høffding was the one who brought the ideas of these thinkers to Niels Bohr.[197] Yet others find no evidence at all that Høffding, Kierkegaard or James influenced Bohr.[198]

What is known is that Bohr came into contact with Høffding at an early date. Høffding was a good friend of Bohr's father, Christian Bohr, who was a professor of physiology. Bohr later (1903) attended Høffding's philosophy classes and remained in touch with him until Høffding's death. He also became a member of the Ekliptika circle, a group of students who had attended Høffding's lectures and who continued to meet in order to discuss various subjects. This circle was organized by Edgar Rubin, later a professor of psychology and Bohr's cousin.[199] On the occasion of Høffding's 85th birthday Bohr spoke of how important Høffding's friendship had been to him.[200] This importance is also stressed in a speech of welcome given at the Tenth International Psychology Congress in Copenhagen in 1932.[201] Bohr obviously discussed the epistemological situation in quantum physics and its relation to problems in philosophy, psychology and biology with Høffding.[202] Bohr had

[196] Feuer, 122–23.

[197] Dugald Murdoch, *Niels Bohr's Philosophy of Physics* (Cambridge, 1987), 225; Jan Faye, *Niels Bohr: His Heritage and Legacy* (Dordrecht, 1991); Folse, 44.

[198] David Favrholdt, 'Niels Bohr's Philosophical Background', *Historisk-filosofiske Meddelelser* 63, Det kongelige danske Videnskabers Selskab (Copenhagen, 1992).

[199] Faye, 19–20.

[200] Niels Bohr, 'Ved Harald Høffding's 85-Aars Dag', *Berlingske Tidende*, 10 Mar. 1928.

[201] This speech exists only as a poor carbon copy. See Faye, 67 ff.

[202] See Faye.

also read Kierkegaard and been deeply impressed by the beauty of his *Stadier paa Livets Vei*, but he is reported also to have said that he could not share Kierkegaard's views.[203] David Favrholdt is of the opinion that Bohr had only an academic appreciation of Kierkegaard's philosophy and had not in any way adopted him as a philosopher.[204] According to Pauli, on the other hand, Bohr had as a young man had a genuine and intense *Auseinandersetzung* with Kierkegaard, in other words he made a thorough study and personal evaluation of Kierkegaard's philosophical viewpoints. In 1930 Bohr had also given Pauli Kierkegaard's *Stadier paa Livets Vej* and *Enten eller*.[205]

Kierkegaard's philosophy has an 'either-or' element to it: the choice in human life is between absolute, qualitatively distinct viewpoints with no intermediate positions. The great tension between opposites does not necessarily have to be resolved by a synthesis but remains antithetical. Progress is considered acausal and indeterminist, consisting of qualitative 'leaps' which disrupt continuity. Kierkegaard called this dialectic *qualitative*, as opposed to Hegel's linear dialectic. According to Kierkegaard, our development cannot be rationalized as a logical, ordered historical process. In every instance it represents a qualitative leap to an entirely new way of looking at the world. The leap is a qualitative unit, complete in itself. Its state cannot be traced backwards, nor can anything be inferred from it with regard to the future. Kierkegaard also drew a sharp distinction between the existential and the scientific, between man and the laws of nature. Acausality rules in the soul, causality in nature.[206]

Høffding, on the other hand, did not wish to make any such division between the domains of the 'soul' and of 'science'.[207] He believed that the 'leap' could very well exist in inanimate nature and referred to recent developments in science: the discovery of radium radiation and Darwin's theory of spontaneous mutations in evolution. These discontinuities also appear in psychology as spontaneous changes in character and new mental formations. Here Høffding refers to the works of William James.[208] The relationship between continuity and discontinuity was a central theme of Høffding's philosophy, as were the concepts of analysis and synthesis. He was convinced of a reciprocal relationship between continuity and discontinuity. The laws of

[203] Murdoch, 228; Faye, 36.
[204] Favrholdt, 62.
[205] Pauli to Goldschmidt, 19 Feb. 1949, Goldschmidt, 25. The books are in 'La Salle Pauli' at CERN, Bellettrarisches Nos. 300 and 301.
[206] Feuer, 122–23.
[207] Harald Høffding, *Filosofiske Problemer* (Copenhagen, 1902), 1–2.
[208] Idem, *Den menneskelige Tanke, dens Former og dens Ogave*, Copenhagen 1910, 288, 185. See also Faye, 39.

nature seem largely based on causality and continuity, conscious experiences appear to be discontinuous. But behind these seemingly disparate parts of consciousness there may be an unconscious coherence or an unconscious continuity. In his discussion of Kierkegaard's concept of the 'leap', Høffding argues in a way that reminds us of Bohr's description of the discontinuities of stationary states in quantum physics:

> But it might be asked, cannot this jerk or this leap itself be made an object of psychological observation? Kierkegaard's answer is not clear. He explains that the leap takes place between two moments, between two states, one of which is the last state in the world of possibilities, the other the first state in the world of reality. It would almost seem to follow from this that the leap itself cannot be observed. But then it would also follow that it takes place unconsciously – and the possibility of the unconscious continuity underlying the conscious antithesis is not excluded.[209]

The principle of totality is a fundamental concept in Høffding's philosophy. Høffding discusses the category of totality in two ways: the first is related to the scientific method of analysis and synthesis, the other to intuition and the fact that certain items appear to us as immediately given wholes.[210] Basically the category of totality represents a human need, something that characterizes both man's psyche and his cognitive process. To see connections and organize them is man's nature, but Høffding assumes that these connections also have a counterpart in nature itself. However the principle of discontinuity is just as real and finds expression in the elementary phenomena of the world, which are part of empirical reality. It is these phenomena that have to be 'overcome' by being ordered in a systematic whole, which represents an aim that can never be entirely attained. Totality seeks continuity, coherence and structure, but is always disturbed by the discontinuity of new facts that unleash bound forces and confront man with the big challenges. In this way the principles of totality and discontinuity are in perpetual conflict, a conflict whose finest fruit is progress and whose worst fate is destruction.[211]

We can see that the typical traits of Bohr's philosophy lie closer to Høffding than to Kierkegaard. As with Høffding his main objective was the reconciliation of opposites. Bohr was not guided by a longing for acausality; rather he always tried to find a way to bring classical and quantum theory closer together and to combine continuity and discontinuity models of nature. He arrived at his principle of complementarity by combining the quantum pos-

[209] Høffding, *A History of Modern Philosophy* (1894–95), Dover, New York 1955, II, 287–88, cited in Faye, 37.
[210] Faye, 91.
[211] Høffding, *Filosofiske Problemer*, 4, 67–68.

tulate (which renounces a causal space-time description) with his conviction of the indispensability of classical concepts (i. e. space-time-causality) to describe a physical situation.[212] So it was not the abandonment of causality that led to the formulation of the Copenhagen interpretation of quantum physics, but simultaneous adherence to the old and acceptance of the new perspective. To Bohr it is a matter not of *either or* but of *both and*.

The main similarity between Kierkegaard and Høffding lies in an open and pluralist view of reality. On the other hand this openness is nothing unique to Kierkegaard and Høffding, but is said to be typical of the Danish intellectual climate in general.[213] Reality is too diverse and complex to be contained in a single system.[214] Høffding emphasized the wonderful contradictions that can be found in all great philosophical systems. These contradictions show that there is always an incommensurability, an *irrational* element in the relationship between reality and thought. Truth does not assume an identity, but only an *analogy*, between reality and thought, and must therefore be regarded as *symbolic*.[215]

The inspiration that Bohr may possibly have received directly from Kierkegaard is the latter's approach to language. Kierkegaard emphasized what he called *indirect communication*. This part of Kierkegaard's philosophy places much emphasis on the liberating function of language. The basic idea in this Socratic ideal is that one can never alter human attitudes or ways of living by attacking them directly. An illusion can never be tackled head-on; indirect methods have to be used. The indirect tools of language are satire, irony, comedy and allegory. With their aid it is possible to arouse people and to lead them to the threshold of knowledge, where they will be able to take the step across for themselves. Many in Bohr's vicinity said that he himself communicated in this way, by telling stories, jokes and analogies.[216] In his tribute to Bohr on his fiftieth birthday, Oskar Klein compared Bohr's philosophy with that of Kierkegaard:

> Niels Bohr, who, with his humour, his extreme conscientiousness, indeed, his whole brilliant thinker personality, belongs to the classical Socratic strain in Danish philosophy – the line of Ludwig Holberg, Poul Möller and Sören Kierkegaard – …[217]

[212] Niels Bohr, 'The Quantum Postulate and the Recent Development of Atomic Theory', *Nature* 121 (suppl.): 580–90.
[213] Favrholdt, 45.
[214] Høffding, 'Philosophy and Life', 150.
[215] Murdoch, 228.
[216] Pais, Abraham, *Niels Bohr's Times, in Physics, Philosophy, and Polity* (Oxford, 1991), 6ff.
[217] Oskar Klein, 'Niels Bohr som tänkare', *Nordisk Tidskrift* 11 (1935), 417.

But this 'humorous' tradition is just as much to be found in Høffding, and Bohr himself refers to 'the spirit of Høffding' with regard to the 'humorous tone':

> I have myself recently given a lecture here in Copenhagen on general human problems in a scientific perspective, in which in order to strike a more 'humorous' note in the spirit of Høffding I took, instead of the Bible, 'En Dansk Students Eventyr' as my starting point... [218]

The quotation mentions Niels Bohr's other great source of philosophical inspiration. In Léon Rosenfeld's summary of Bohr's epistemological outlook, Poul Martin Møller's little book *En dansk Students Eventyr* (The adventures of a Danish student) is credited with a crucial role in Bohr's philosophy.[219] During the final years of his life Poul Martin Møller was a teacher of philosophy at Copenhagen University. Kierkegaard, who was a university student at this time, found in Møller a kindred spirit. *En dansk Students Eventyr* is about two cousins, one holding a licentiate and the other a master's degree, who discuss the meaning of this and that. The licentiate and the master have very different personalities – the licentiate is a dreamer, irresponsible and constantly in love, and has a propensity for philosophical musing. The master, on the other hand, is educated, with a very practical and down-to-earth nature. When the master says that the young licentiate ought to stop ruminating and get a job, the licentiate says that it is his endless questions that prevent him from achieving anything. As soon as he starts wondering about his own situation and what he can do about it, he also starts reflecting on his own thoughts:

> And then I start to think about my thoughts about it, yes I'll think about the fact that I'm thinking about it, and split myself up into an infinite receding row of one me after the other, each one contemplating the next. I do not know which one to stop at as the real one, and the moment I stop at one, there's another me, standing there. I get dizzy and feel faint, as if I were staring into a bottomless pit, and the thinking ends with me having a terrible headache.[220]

This picture of the paradox of human thinking formed, says Rosenfeld, the basis of Bohr's whole epistemology:

> ... it is hardly an exaggeration to say that the perplexities of this licentiate, especially his struggle with his many egos, were the only object lesson in dialectical thinking that Bohr ever received, and the only link between his highly original reflection and philosophical tradition.[221]

[218] Bohr to Oskar Klein, 5 Jan. 1940 – Oskar Klein Papers, *Niels Bohr Archive*, Copenhagen.
[219] Léon Rosenfeld, 'Niels Bohr's Contribution to Epistemology', *Physics Today* (October 1963), 48.
[220] Poul Martin Møller, *En dansk Students Eventyr* (Copenhagen, 1911), 38–39.
[221] Rosenfeld, 'Niels Bohr's Contribution to Epistemology', 48.

Although Rosenfeld is obviously exaggerating when he says that Møller's reproduction of the licentiate's battle with his different egos was Bohr's *only* lesson in dialectic thinking, it is undeniable that Møller's short story was very important to Bohr. He often quoted long passages from it to his colleagues to illustrate the epistemological situation in quantum physics.

Rosenfeld claims that Bohr's interest in philosophical and epistemological questions did not arise from his work on the problems of physics but derived from his general epistemological interest in the function of language as a vehicle for the communication of experience. The licentiate's attempt to sort out his various egos is merely an overexplicit example of a more general problem, where the same words are used in different contexts to describe different, even mutually exclusive, experiences. Bohr's problem was how in such cases one could avoid ambiguity. In his search for a solution he was guided by the analogy of multivalued analytic functions in mathematics, such as the Riemann surface.[222] The Riemann surface must have been a popular analogy; Pauli also used it in his discussions with Jung concerning the concept of synchronicity. Bohr argued that just as the value of a multivalued analytic function is divided between different Riemann surfaces, the use of everyday concepts must be limited to one and the same 'surface', i. e. level of objectivity. Ambiguity arises when concepts refer to different levels of objectivity, a risk especially pronounced in concepts referring to our own mental activity. In mathematics we avoid the risk by forbidding self-reference.

The essential thing about Riemann's model is that all branches of this multivalued analytic function are perceived as a single function. In the same way there is often only one concept in the everyday language to describe different aspects of our mental experience (like the concept of 'I' in Møllers story). We cannot, therefore, hope to rid ourselves of the ambiguity of language by creating new concepts, we must instead be aware of the reciprocal relationships of the different levels of objectivity as fundamental irreducible units. The origin of the particular problems of human language may be found in man's position in the universe, in other words in his ability to make himself an object of observation. To illustrate this, Bohr used often to quote a passage from *En dansk Students Eventyr*, where the licentiate says:

> In this way man divides himself on many occasions into two persons, of which one seeks to deceive the other, while a third, who is basically the same as the other

[222] Bernhard Riemann, a German mathematician in Göttingen who facilitated the study of multivalued analytic functions by introducing a kind of multi-plane surface. He also demonstrated a third fully independent geometry (the elliptical), which was to have great significance in the general theory of relativity.

> two, wonders mightily at this confusion. To sum up, thinking becomes dramatic and quietly plays the most complex intrigues with itself and for itself; but the observer repeatedly becomes an actor again.[223]

Time and again Bohr stressed that man's unique position means that we are both actors and spectators in the great theatre of existence.[224] It is this basic idea of the dualism of human experience which, according to Rosenfeld, we find in Bohr's epistemology: willingness to encounter different aspects of the same thing and insight into the pointlessness of trying to reduce the one aspect to the other. Instead the need for an unambiguous definition of concepts by reference to a common experience is emphasized. Objectivity is guaranteed by unambiguous communication.[225] Here we see how we find both functions of language in Bohr's philosophy: the logical, unambiguous and direct communication which is to guarantee objectivity and the humorous allegorical or indirect communication which is intended primarily to show the limitations of everyday language and get us to realize that the reality which 'dwells in the deeps' can only be described with the aid of metaphors. It is in fact the same insight as that of Nietzsche, Wittgenstein and Gödel: the more exact and logical your description (clarity), the further away you are from a complete description (truth), which always demands several, even mutually exclusive, perspectives. Another way of putting it is that you can give an exact description of something if you limit the description to concern a partial aspect only. This is what is meant with the complementarity of clarity and truth, which is expressed in Schiller's poem *Spruch des Konfuzius*.

Bohr, Pauli, Heisenberg and the Advent of the Quantum Theory

In many quarters, the philosophy of Niels Bohr and the Copenhagen school has been called positivist. Elsewhere it has been argued that Bohr, unlike for example Pauli and Heisenberg, was not a positivist at all but a kind of modified realist.[226] As a great deal of the debate surrounding the Copenhagen School's interpretation of quantum physics concerns its relationship to positivism, realism, anti-intellectualism and mysticism, it is important to create some sort of order among these concepts. Much depends on how they are defined. In Forman's example, for instance, the positivist scientific ideal becomes the

[223] Møller, 41–42.

[224] Niels Bohr, 'The Atomic Theory and the Fundamental Principles Underlying the Description of Nature' (1929), *Collected Works of Niels Bohr*, 253; idem, 'Biology and Atomic Physics', 20; idem, 'Unity of Knowledge', 81.

[225] Rosenfeld, 'Niels Bohr's Contribution to Epistemology', 49–50.

[226] For example Folse, 222 f.

antithesis of Husserl's phenomenology. On closer inspection, however, it can actually be seen that Husserl's phenomenology has certain similarities with one kind of positivism. We may begin by looking more closely at the advent of the quantum theory in the so-called Copenhagen School version.

Some historians of science argue that the formulation of a physical theory is more often than not determined by various personal, temperamental, aesthetic preferences of the scientist.[227] The advent of quantum physics was guided in particular by the fact that scientists preferred either the continuity or the discontinuity picture of reality, visual models or abstract formalism, wave or particle pictures of light and matter. The period 1926–27 was governed by intense personal disputes between the personalities involved, where these themes were decisive. Bohr, for example, had a preference for the wave or the frequency picture of light, a preference he retained for his entire life. He clung to it and found difficulty in accepting the existence of the photon. Heisenberg, on the other hand, started with the particle/kinematic perspective.

The loss of visualizability (*Anschaulichkeit*)[228*] in the early 1920s was very painful to Bohr, who was used to experimenting with visual concepts, such as the image of the atomic model as a little planetary system. Only slowly and very doubtfully did Bohr struggle towards the abandonment of the causal description of time and space in the atomic world. The exaggerated emphasis on the quantum leap in the historiography of the birth of quantum physics tends to overshadow the fact that the primary intention behind Bohr's theory was to describe atomic stability with the aid of the quantum postulate.[229] Bohr cannot therefore be regarded as a revolutionary in the sense that his intention was to break with the old physics and create a new worldview. Whereas Bohr clung to classical concepts that corresponded to classical visualizability, Pauli and Heisenberg insisted that visualizability had to be sacrificed and that new concepts had to be derived from experience. Bohr's complementarity

[227] Arthur Miller, *Visualization Lost and Regained*; Gerald Holton, *Roots of Complementarity*, 132; Beller, 234.

[228*] The translation of the term *Anschaulichkeit*, *anschaulich* and *Anschauung* is not altogether easy. *Anschaulich* is used together with the German word for picture (*Bild*), and refers to the classical visual models, i. e. the atom as a planetary system. *Anschauungen* is also closely associated to classical physics and its link to perceptions, while *Anschaulichkeit* was the issue of conflict between Heisenberg, Bohr, Pauli and Schrödinger. *Anschaulichkeit* is linked to the possibility of grasping an abstract reality beyond our perceptions. Miller uses the words 'visualizability for *Anschaulichkeit*, 'intuition' for *Anschauung* and 'intuitive' for *anschaulich*. I will use 'visualizability' for *Anschaulichkeit* as well, but avoid the terms 'intuitive' and 'intuition' because they will be used with a specific meaning later. Instead I will use 'visual' or 'visual model' for *anschaulich*, 'non-visual' for *unanschaulich* and 'classical view' for *Anschauungen*. In the English translation of the Pauli-Jung letters *anschaulich* is translated as 'illustrative', not a very good choice in my opinion. Arthur I. Miller, *Imagery in Scientific Thought* (Boston, 1987), 128–29.'

[229] Hendry, *The Creation of Quantum Mechanics*, 35.

principle took shape as Bohr, unlike Pauli and Heisenberg, fought to retain causality without having necessarily to give up the quantum postulate.

Pauli and Heisenberg could not understand why Bohr was at such pains to retain the wave picture of light. They accepted the Bothe-Geiger results as evidence of the light quanta. Heisenberg built his highly abstract matrix mechanics on the particle perspective alone, and was willing to abandon classical space-time parameters and replace them with abstract algebraic constructs. Pauli concentrated on a conceptual critique of classical concepts like 'orbits'; his matter of heart was an operationally well-defined conceptual apparatus with clear relationships between the different operational definitions.[230] It was in dialogue with Pauli that Bohr developed his ideas on complementarity so as to include the duality of wave and particle (Bohr's complementarity concerned space-time and causality). Bohr, in turn, convinced Pauli that the classical concepts had to be retained because only they guarantee unambiguous communication of experimental results and therefore an objective description of phenomena.[231] The experimenter's experience of the observation instruments represents everyday experience in time and space and it is therefore impossible to dispense with everyday language in physics. Only the classical concepts of time and space can refer directly to experience concerning the observation instruments and thus offer an unambiguous description of the experiment.

Pauli had to yield to Bohr's demand for communicability, but on the other hand Bohr had to give way to Pauli and Heisenberg as far as the demand for classical visualizability in physics was concerned. Pauli considered that one had to leave the old visual thinking behind and concentrate on finding concepts that correspond to experience. As all the mechanical models had failed, Heisenberg, to whom abstract thinking was very appealing, was convinced that in future it was necessary to rely entirely on the mathematical formalism of quantum theory. Between these three viewpoints was created the quantum mechanics of the Copenhagen School. Pauli stressed the need for new concepts based on observation and experience and he criticized field and continuity theories. Bohr clung to the wave picture of light and to the importance of classical concepts and their visualizability and continuity, while Heisenberg strove for unity with the aid of mathematical formalism.

Although there remained disagreements between those who had contributed to the Copenhagen interpretation of quantum physics, they gathered behind a unified version that was officially presented:

[230] Pauli to Bohr, 12 December 1924, *PLC I*, [74], 188–189.
[231] Hendry, 'Pauli as Philosopher', 281.

1. The uncertainty relation postulated by Heisenberg in 1926 laid down that the path of the microphysical particle cannot be predicted, because position and momentum cannot be determined at the same time.[232] With Heisenberg's uncertainty relation it becomes necessary to choose whether one wants to measure the position of the particle or its momentum. Furthermore a precise measurement of the one component rules out a precise measurement of the other. This means that general laws no longer govern each individual occasion of measurement but apply to a statistically significant number.
2. It is impossible to break down the experimental apparatus into its components (measuring apparatus and measured object) without influencing the physical phenomenon in an unforeseeable manner. Every measuring situation thus acquires a character of *individuality* or *indivisible wholeness*. Generalization is now not absolute but statistical. Modern physics therefore includes the existence of unique, unpredictable units.
3. The visual and complementary images of wave and particle are by all means necessary descriptions, but they have to be regarded as abstractions and idealizations. Visualizability is retained only as a heuristic value. – It is, however, impossible to use the classical concepts to describe a *reality independent* of us. The classical concepts describe only the *phenomenological* objects.[233]
4. Wave and particle give a *symbolic description*, and not a description of independent physical reality. It is symbolic because it allows two descriptions of different, mutually exclusive observations to give complementary information on the same atomic object. The symbolic description refers to an abstraction or to a non-visual reality, which cannot be translated into everyday terms or images.
5. The classical concepts and the unambiguous communication of the experimental results guarantee objectivity.

[232] The uncertainty relation expresses the mathematical implication of the formalism of quantum mechanics, that is to say the fact that it is impossible to define the state of a physical system in precise values with the parameters that determine its classical mechanical state. Therefore it is not possible in quantum mechanics to give both a temporal and a spatial description that state the exact position of the components of the system and an exact determination of motion and energy. The more accurately one wishes to establish the position of a particle, the more uncertain becomes the determination of its energy or velocity. Put another way, it may be said that the less we can define the future state of a system (by waiving the causality requirement), the better we can satisfy the observational ideal (the spatial determination). This means that the particle might in fact be able to exist in a well-defined classical state, but that due to observational interaction we cannot ascertain this with the same degree of exactitude. It also means that the observer has to choose what he wants to observe.

[233] Ibid., 164–65.

This in turn leads to a reformulation of:

- The scientific object
- Objectivity
- Science as an activity

The material with which one has traditionally worked in classical physics has been the naively perceived object. However a contradiction arose when both the wave and the particle picture were found necessary for a complete description of observed facts. To restore the freedom from contradiction Bohr therefore laid down that in the new physics the building blocks are not the real material objects, but *physical phenomena*. A physical phenomenon is defined as the interaction between measuring instrument and measured object. For this reason the classical definition of 'objectivity' loses its meaning. Objectivity had previously been synonymous with a correct reproduction of the conditions of objective reality. Now that this was no longer possible Bohr gave the concept of scientific objectivity a new definition. Objectivity lies in, according to Bohr, 'an unambiguous description of the process of observation', that is to say a clear and unequivocal communication of our experiences.[234] In the same way physics and the description of nature were no longer described as a way of 'revealing the true nature of phenomena', but as a way of 'tracing connections in the diversity of our experience'.[235] The difference between the perspectives of classical physics and those of the Copenhagen School was therefore rooted in different views of the basic philosophical concepts: objectivity, phenomenon, causality and physical reality. The actual revolution in the philosophical foundations of physics consisted in Bohr's seeing himself as obliged to redefine these concepts in order to retain them within the framework of the new physics. At the same time this meant a redefinition of the criteria of science.

These three points – observation as interaction, objectivity as unambiguous communication and knowledge as a method of summarizing our experience – all show a shift towards the observer, the human role in science. This reorientation towards human experience was nothing unique to physics. As we have seen, the whole turn-of-the century period may be said to have been permeated by this tendency.

[234] Niels Bohr, 'Unity of Knowledge' (1954), *Atomic Physics and Human Knowledge* (New York, 1958), 67–68.

[235] Idem, 'Atomic Theory and Description of Nature: Introductory Survey' (1929), *Collected Works of Niels Bohr* 6, ed. Jørgen Kalckar, (Copenhagen, 1985), 296.

Pauli and the Creation of Modern Physics

We have already touched on what characterized Pauli as a physicist and researcher in the group surrounding Niels Bohr: both verbally and in writing he acted as a discussion partner and a sounding board. He became particularly known for his outstanding critical severity, his clarity and his uncompromising honesty. Bohr called him 'the conscience of theoretical physics', while Heisenberg called him 'the master of criticism'.[236] Paul Ehrenfest gave him the name 'the scourge of God' (*Die Geißel Gottes*) for his unrelenting ability to clarify problems and to criticize obfuscations.[237] Victor Weisskopf describes him as follows:

> The famed acuity of his criticism, the relentlessness and irony with which he fought against false ideas, the wit and the scorn with which he opposed things that seemed to him half-hearted and artificial, were the expressions of his striving for ultimate clarity and purity in science and in human affairs.[238]

Pauli could not tolerate anything obscure or banal and he set higher standards than his colleagues with regard to what made scientific work valuable. A typical reaction by Pauli on seeing a trivial manuscript was: 'It isn't even wrong!'[239] He always focused on the problems that were still unsolved, not least with regard to his own contributions to physics.[240] His letters were regarded as an institution in their own right and were put up on the notice board to give everyone the benefit of his wisdom. In a fourteen-page letter to Heisenberg on 19 October 1926 he discusses the guidelines that led Heisenberg to the formulation of the uncertainty principle. In Pauli's wording we can already recognize what later came to form part of its definition:

> The first question is why only the p's, and in any case not *both* the p's and also the q's, both may be stipulated with whatever precision is desired.[241]

Pauli is called the last Universalist in physics, competent in every fundamental area of the subject. Among his colleagues he was seen as the ultimate authority and judge when the correctness of a hypothesis was being assessed. The approval of Pauli was something everyone wanted before publishing his or

[236] Bohr to Weizsäcker, 18 Dec. 1958 – BSC, mf. 33, *AHQP*. 'At the moment we are all deeply distressed by Pauli's death, which is such a loss to physicist circles the world over, to whom he came, with his insight, to be to an increasing degree the conscience of our profession.' See also Heisenberg to Pauli, 21 Nov. 1925 [107], *PLC* I, 261.

[237] Pauli to Kramers, 8 Mar. 1926 [125], ibid., 307.

[238] Victor F. Weisskopf, 'Vorwort', ibid., VII.

[239] Ibid., VI.

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

[241] Pauli to Heisenberg, 19 Oct. 1926 [143], ibid., 346.

her theories, results or hypotheses. 'I have never published a work, without Pauli having read it first', said Heisenberg.[242]

Pauli's greatest contribution to quantum physics is said to be on an epistemological level.[243] Although it is mainly in Pauli's later correspondence that his epistemological and psychological interests become prominent, this interest actually begins early. When considering the problems of physics in the 1920s, Pauli's decidedly epistemological position is already evident. To the founder of the Vienna School of logical positivism, Moritz Schlick, he writes: 'I am already very much looking forward to your lecture, for I have a great interest in the theory of knowledge and in natural philosophy, although I feel that I am entirely a layman there.'[244]

Pauli's interest and competence in epistemology are often attributed to his early contact with Ernst Mach. As his godfather, Mach had acquired a responsibility for guiding the young Wolfgang's early education. Pauli often went home to Mach and Mach dedicated copies of his books *Die Mechanik* and *Populär-wissenschaftliche Vorlesungen* to the thirteen-year-old boy. However Pauli never accepted Mach's whole philosophy, root and branch. Even at that age, he was critical of Mach's view of the humanities. In *Populär-wissenschaftliche Vorlesungen* Mach outlines an educational programme in which the humanities are treated as more or less inessential knowledge. Mach complains that reading Greek and Latin literature is virtually the only instruction given to young students. As a result of the disproportionate emphasis on the classics, students with an interest in science are insufficiently prepared for their real subject field.[245] Pauli has underlined these lines in his copy and written in the margin that it is a gross exaggeration on Mach's part to claim that reading classics is virtually the only instruction in the elementary school.[246] Mach also believed that it would be more rewarding to study antiquity from a scientific perspective, for example to approach Herodotus from a knowledge of the Stone Age and its pile dwellings. A correct teaching of history, which is to say a teaching of history which is not merely a patriotic account of the past of one's own country, could very well replace the reading of the Greek classics. In his copy of the book the young Pauli has noted beside this passage that one can only learn the culture of

[242] Armin Hermann, 'Die Funktion und Bedeutung von Briefen', *PLC* I, XLII.

[243] 'Perhaps Pauli's most important achievement in 1926 was his contribution to the physical epistemological analysis of the quantum theory.', Hermann, 'Die Funktion und Bedeutung von Briefen', XV.

[244] Pauli to Schlick, 21 Aug. 1922 [23a], *PLC* II, 692.

[245] Ernst Mach, *Populär-wissenschaftliche Vorlesungen* (Leipzig, 1910), 322–24.

[246] Pauli's copy of this book is in 'La Salle Pauli', CERN, Wissenschaftliches, No. 268. In the margin of page 322 is the note 'But is not an inevitable consequence of the teaching of classical languages!'

a people from its literature.[247] No true cultural history can dispense with the literature.

Mach's contribution to Pauli's position is described in a letter to Jung:

> Among my books there is a somewhat dusty case, containing a Jugendstil silver goblet, and in this goblet is a card. A gentle, benevolent, and cheerful spirit from days of yore seems to be issuing forth from this goblet. [–––] This goblet is a baptism goblet, and on the card it says in an old-fashioned ornate script: 'Dr. E. Mach, Professor at the University of Vienna'. It so happened that my father was very friendly with his family, and at the time totally under his influence mentally, and he (Mach) kindly agreed to take on the role of my godfather. He must have had a stronger personality than the Catholic priest, with the apparent result that I was thus baptized in an antimetaphysical manner rather than in a Catholic one. Be that as it may, the card remains in the goblet, and despite all the great mental changes I went through later on, it remains a label that I myself bear – namely: 'of anti-metaphysical origin'.[248]

What does Pauli mean by an anti-metaphysical baptism? The simple answer is that he demands that every statement or concept must be *possible* to check by experience (empirically) or by logic.[249] This 'anti-metaphysical' outlook is stated not only to characterize Pauli's successes in physics, but also to be a feature of the rise of quantum physics as a whole. In analyses of Pauli's scientific thinking it is said on almost all sides that he was a positivist who advocated an operational method, an approach which had a decisive influence on the formation of modern physics. In some accounts it is said that he was undoubtedly a positivist in the 1920s, but that in later life he abandoned this position to become a *realist*, as it is called in one place, or to become a *Platonic-Pythagorean idealist*, as is stated elsewhere.[250] As an example of Pauli as a 'confirmed positivist' in the 1920s, the letter to Moritz Schlick, just

[247] Mach, *Populär-wissenschaftliche Vorlesungen*, 326. In the margin of Pauli's copy is the comment: 'I would very much doubt it! You only learn the culture of a people from direct contact with its literature!'

[248] Pauli to Jung, 31 Mar. 1953 [60], *PJL*, 104 f.

[249] Pauli to Jung, 31 Mar. 1953 [60], *PJL*, 105; Pauli to Jaffé, ca. 10/11 April 1953 [1551], *PLC IV/2*. But he also defines the concept of metaphysics as opposite to the concept of complementarity. Most important to him is the epistemological insight that metaphysics and anti-metaphysics constitute a complementary pair, which always compensate each other psychologically. In other words one also has to be wary of identifying oneself with an anti-metaphysical position because this will automatically create a metaphysical counter-position in the unconscious, i. e. an unshakeable belief in what ultimately constitutes reality. Pauli to Jaffé, ca. 10/11 April 1953 [1551], Pauli to Fierz, 11 April 1953 [1552], *PLC IV/2*.

[250] John Hendry, 'Pauli as Philosopher', *British Journal of Philosophy of Science* 32 (1981), 279; Karl von Meyenn, 'Pauli's Belief in Exact Symmetries', *Symmetries in Physics (1600–1980), Proceedings of the 1st International Meeting on the History of Scientific Ideas held at Sant Feliu de Guíxols, Catalonia, Spain, Sept. 20–26 1983*, eds. Manuel García Doncel (et al), (Barcelona, 1986), 332; Kalervo V. Laurikainen, *Beyond the Atom: The Philosophical Thought of Wolfgang Pauli* (Berlin, 1988), 15–20. Those who call Pauli a 'Platonist' are naturally alluding to his interest in Jung's theory of archetypes.

mentioned, is cited: 'I now consider positivism a perfectly unobjectionable and incontrovertible view of the world.' The next sentence in the letter is less frequently quoted, although in my view it alters the picture somewhat: 'Naturally however it is not the only one possible.'[251] The strongest reasons for calling Pauli a positivist are found in his scientific outlook and working method in the 1920s.

In his very first publications, which dealt with the work of the mathematician Herman Weyl, Pauli added epistemological comments in a 'typical positivist spirit'.[252] He stressed, for example, that the concept of *electric field strength* had to be regarded as a fiction devoid of content because we have no way of measuring it. In physics one should stick to observable (which means measurable) quantities.[253] Pauli expressed the same sort of criticism in 1924 in a letter to Niels Bohr in connection with the fact that the inadequacies of Bohr's atomic model had become apparent and efforts were being made to find a new way of describing atomic phenomena. The most important thing in such a situation, according to Pauli, was not to be hamstrung by preconceptions but rather to adjust the concepts to our experience.

> The (still unattained) goal must be to deduce these and all other physically real, observable properties of the static condition from (all) the quantum numbers and the laws of quantum theory. However we must not seek to bind the atom in the fetters of our prejudices (which in my opinion also include the assumption of the existence of electron orbits in the conventional kinematic sense), but we must, on the contrary, adapt our concepts to experience. [–––]
>
> Of this I am sure – despite our good friend Kramers and his colourful picture books. – 'And the children, they like to hear it.' Even if the demand of these children for visualizability is to some extent a justified and healthy one, this demand must never count in physics as an argument for the retention of certain systems of concepts. Once the systems of concepts are clarified, the new ones will also become visual.[254]

Pauli is said also to have had a decisive influence on Heisenberg's epistemological position and thus on his investigation of quantum physics. Heisenberg's physics was initially very formalist. That he gradually abandoned this formalism and instead concentrated on basing his physics on observable quantities alone has a very 'positivist' stamp. Unlike many other physicists, however, Heisenberg was negatively disposed to the philosophy of Ernst Mach and

[251] Pauli to Schlick, 21 Aug. 1922 [23 a], *PLC* II, 692. See also Meyenn, 'Pauli's Belief in Exact Symmetries', 336.
[252] Laurikainen, 16.
[253] Hermann, 'Die Funktion und Bedeutung von Briefen', XIII.
[254] Pauli to Bohr, 12 Dec. 1924 [74], *PLC* I, 188–189.

had no real sympathy for positivist thinking.[255] One reasonable explanation of Heisenberg's readjustment must have been a strong influence on Pauli's part.[256] Writing to Niels Bohr, Pauli initially lamented Heisenberg's 'unphilosophical' attitude.

> He always makes me feel very strange. When I think about his ideas, they seem awful, and I curse inwardly about them. For he is very unphilosophical, he has no respect for clear development of the basic assumptions and the way they fit previous theories. But if I talk to him, I like him very much, and I see that he has all kinds of new arguments – at least in his heart. I then find him – quite apart from the fact that he is also a very nice person – very significant, even brilliant, and believe that he will contribute to great advances in science. [–––] I hope Heisenberg will then bring home a more philosophical focus to his ideas.[257]

Heisenberg studied for a while under Max Born in Göttingen, studies that, Pauli thought, could only damage Heisenberg as a physicist. Pauli was not slow to say this to Born himself: 'Yes, I know you are fond of tedious and complicated formalisms. You are only going to spoil Heisenberg's physical ideas by your futile mathematics…'[258] In October 1925 Pauli wrote to Ralf Kronig that further efforts must be made to liberate Heisenberg's physics from Göttingen's formal 'torrent of erudition' (*Gelehrsamkeitsschwall*) in order to reach its physical core.[259] However his letter to H.A. Kramers on 27 July 1925 shows that he already thought that Heisenberg was moving in the right direction. With Bohr, Heisenberg had at last learned to think less formally and more philosophically.

> I have also perceived with joy that Heisenberg has learned a little philosophical thinking in Copenhagen with Bohr and moved perceptibly away from the purely formal. I therefore wish him success in his efforts with all my heart! I now feel less lonely than six months or so ago when I felt as if I was (mentally and spatially) rather alone between the Scylla of the Munich School's numerical mysticism and the Charybdis of the Copenhagen reactionary putsch, which you recommend with such an excess of zeal! Now I hope of you only that you will delay no longer the recuperation of Copenhagen physics, which cannot fail to take place, given Bohr's strong sense of realism.[260]

What, then, was Pauli's epistemological position? As we have already seen, Pauli rejected the use of concepts that do not correspond to observable or measurable quantities. Just as Einstein's work on the theory of relativity started from Mach's criticism of the concepts of time and space, so a ques-

[255] Folse, 227.
[256] For a more critical assessment on this issue, see Beller 54 ff.
[257] Pauli to Bohr, 11 Feb. 1924 [54], *PLC* I, 143–44.
[258] Max Born, *My Life: Recollections of a Nobel Laureate* (London, 1978), 218.
[259] Pauli to Kronig, 9 Oct. 1925 [100], *PLC* I, 247.
[260] Pauli to Kramers, 27 Jul. 1925 [97], ibid., 234.

tioning of physical concepts which do not relate to measurable quantities formed the core of Pauli's epistemological criticism. *Electron orbits* were an example of a concept that could not, from this point of view, be credited with any physical reality. According to Pauli, the main problem of the new physics was that it had been necessary to give up the classical laws of nature, but that their concepts were still being used. Pauli therefore considered it necessary to create entirely new concepts that could be given an operational definition, i. e. a definition based on what is actually observed. Here Pauli's conceptual criticism bore much of the imprint of Ernst Mach. If this means that Pauli can be designated a positivist, then it is not possible to differentiate between Pauli's 'early' and 'late' thinking. For this remained his position all his life, and it forms an important component of his attitude to the psychology of C.G. Jung. I do not by this wish to maintain that there is no difference between the young (pre-1932) and the older Pauli. Pauli describes himself as having been 'a cold and cynical devil', 'a fanatical atheist' and 'an intellectual ›enlightener‹' in his younger years.[261] He refers to the naive certainty that he felt during his time in Hamburg when he could still dismiss all so-called pre-scientific and religious conceptions as 'stupidity'.[262]

In the 1920s Pauli recommended the merits of what he called a *phenomenological* viewpoint. This had become necessary because it was impossible to trace the regularities that had been found in atomic physics back to known models. In 1923 Pauli writes to Alfred Landé that the whole complex of questions has to be dealt with phenomenologically, without thinking in terms of models. A few months later he writes something similar to Arthur Eddington.[263] What Pauli therefore calls a phenomenological method in physics is the study first and foremost of what is shown by measurement, that is to say the physical phenomena. It is probable that Pauli borrowed the term 'phenomenology' from Ernst Mach. Mach is usually described as a *phenomenalist*, as phenomenology and phenomenalism are normally treated as two different philosophical theories. Phenomenalism is the opinion that all experience can be reduced to perceptible phenomena or sense data. Mach himself, however, called his method universal *phenomenology*.[264]

[261] Pauli to Jung, 24 May 1934 [30P], *PJL*, 27. '- Ich war in der ersten Lebenshälfte zu anderen Menschen ein zynischer, kalter Teufel und ein fanatischer Atheist u. intellektueller ›Aufklärer‹.' *PJB*,31.

[262] Pauli to Hecke, 20 Oct. 1938 [534], *PLC* II, 606.

[263] Pauli to Landé, 23 May 1923 [35], *PLC* I, 87; Pauli to Eddington, 20 Sep. 1923 [45], ibid., 118.

[264] Phenomenology as a philosophical school is based on what is referred to as 'the given', i. e. what is immediately present to consciousness (Fainoménon: what is shown), beyond our preconceptions. It also includes the philosophies of Hegel, Husserl and Heidegger. What distinguishes philosophical

Pauli, like many other physicists, shunned philosophical labels and would therefore never accept the title 'positivist', 'empiricist' or 'phenomenalist'.[265] Despite this it is justifiable to say that Pauli embraced a phenomenological attitude as one of his basic guidelines (the other three being a 'physical feeling' [*physikalisches Gefühl*], mathematics and complementary thinking). He saw the phenomenological position as one that obliges us to observe phenomena as they reveal themselves, without taking refuge in finished models, preconceived opinions and prejudices. With the years, however, his view of what ought to be regarded as a phenomenon changed considerably. A phenomenon may be both elementary and complex, and along with sensory impressions the world of phenomena must include spontaneous thoughts and ideas. Everything which is directly given to our consciousness and which evades our arbitrariness – everything that presents itself to us – this is the reality of phenomena.[266] With reference to the Copenhagen School's interpretation of quantum physics Pauli did not think it possible to distinguish between perception itself and the apparatus of perception. Both of these, that is to say the actual perception of something and the ordering and rationalizing activity that belongs to man's spontaneous treatment of perception data, have to be included in the definition of a phenomenon. Phenomena are, admittedly, directly given to us, but they always constitute a result of an interaction between perception data and perception apparatus. Phenomena represent empirically determinable and verifiable reality.

However neither life nor science can be built on verifiable phenomena alone. Man also works on all occasions with metaphysical or theoretical non-verifiable assumptions from which he then draws certain verifiable conclusions. Simply put: a scientist only knows what is observable when he has a notion of what is meant by 'Reality'. And such a notion is always metaphysical.[267] Man's knowledge is generated in a field of tension between spontaneously perceived reality and a metaphysical worldview made up of

phenomenology from Mach's 'phenomenalism' is that the observer is not regarded as a passive recipient. All scientific activity includes intentionality and thus all perception includes a creative process. You always choose what you observe. As a *methodological position* we find the phenomenological approach in among others William James and the sociologists Emile Durkheim. Many sought support in a phenomenological viewpoint in order to use it to create an independent discipline, which did not have to be subordinated to an existing intellectual tradition. This also applies to Jung and his concept '*the reality of the psyche*'.

[265] Pauli to Fierz, 11 April 1953 [1552], *PLC IV/2*.

[266] Although this position is quite reminiscent of philosophical phenomenology, Pauli had no time for it. 'I have never tried to understand Heidegger (I am inclined to regard him as a ›charlatan‹), I have noticed only one – as it appears to me, psychologically informative proposition of his: ›Nothingness noths‹ [*Das Nichts nichtet*].' Pauli to Fierz, 12 Aug. 1948 [971], *PLC* III, 558.

[267] Pauli to Kröner, 29 June 1953 [1593], *PLC IV/2*.

hopes, desires, striving and the degree of knowledge previously attained. A coherent scientific theory contains, according to Pauli, a system of thought based on mathematical equations and rules that are in turn linked to reality. It is never really possible to decide which comes first: the idea (thought) or the experiment (experience). All observation of phenomena is based on an earlier understanding, but observation can also overturn this understanding. It is absurd to believe that theories can be derived from imperative logical conclusions, which is the position of neopositivism.[268]

Only the world of phenomena can be verified and in that sense it is the only *real* and non-metaphysical thing. On the other hand we can only observe phenomena if we already have an idea or conception of what we consider real. A scientific theory is verifiable against the laws of logic and mathematics, but always also contains metaphysical and non-verifiable components. These structural elements are always conditional and hypothetical and are only to be used to the extent that they fulfil an explanatory or productive function. Pauli stuck to his phenomenological standpoint in the sense that he wanted to take up a position midway between empiricism and rationalism. Pauli also retained his conceptually critical stance all his life and detested unwarranted verbosity and conceptualization that had no basis in empirical phenomena. After his encounter with Jung he more and more emphasized the creative aspect of science, i. e. the lucky 'flash of wit' or brilliant idea that comes to you. This aspect is decidedly irrational according to Pauli and can never be reached by rational methods alone (observation and logic). Instead he wanted to see the irrational as an integrated part of nature, both in man and in matter, working at a deeper level as some sort of constructive force.

The Copenhagen School and Positivism

Positivism is today usually associated with something negative. It has become a pejorative concept, describing a narrow empirical and materialistic view of reality in which a kind of simplified mechanical idea of science is used as a model. Positivism sets up those sciences that use observation and controlling experiments as an ideal for all other sciences. This kind of positivism is *ontological*; it reflects a view of what is considered real. Ontological positivism has to be distinguished from positivism as an *epistemological* attitude or method which is used as a tool in scientific work, but which does not have anything to do with how reality is seen in general.

[268] Wolfgang Pauli, 'Phenomenon and Physical Reality' (1957), *Writings on Physics and Philosophy*, 127 f.

We have noted that Einstein was inspired by Mach's conceptual criticism when he formulated his theory of relativity. The positivists of the Vienna Circle used to take this as evidence of how successful the positivist epistemology had proved to be. They felt that Einstein's truly pioneering discoveries could be directly traced back to his early positivist epistemology. In his later years he moved in an increasingly 'metaphysical' direction and expressed a more dismissive attitude to positivism, and he also – accordingly – reaped fewer scientific successes. However the fact is that Einstein had never given his unqualified support to positivism even while young: 'I do not curse the little Machian steed; [...]. But it cannot bring forth anything living, only trample down harmful vermin.'[269] He saw positivism as an adequate critical instrument. A positivist approach can help to clear away misleading questions. On the other hand it cannot in any way promote the creative side of science, the activity that is based on establishing connections and creating a worldview.

Just as the positivists of the Vienna School wanted to link the discovery of the theory of relativity to positivist epistemology, so did they also wish to claim that it was positivism that had produced the successes of quantum physics. Heisenberg's pronouncement in the magazine *Erkenntnis* was seen as further evidence that the latest developments in physics confirmed the position of the Vienna Circle:

> One can only do physics with *processes of observation*, not with the *observed object alone*. This is because physics has shown it to be relevant that observation causes an interaction between the system and the observer, which plays an important part in the physical process.[270]

It was statements like this that led the philosophers of the Vienna Circle to assume that the physicists of the Copenhagen School shared their epistemological viewpoint: physics deals primarily with observations and not with objects. The positivists of the Vienna Circle regarded their philosophy as the handmaiden of the special sciences – it was a purely 'intrascientific' discipline that was based entirely on the logical premises of the new physics itself. At the same time they still saw themselves as somehow superior to the physicists, especially in the area of logical analysis. The mission of philosophy was to analyse the internal coherence of scientific concepts in order to help physicists to clarify their language. It was pointed out that their inad-

[269] Einstein a Besso, 13 May 1917, [35](E.27), *Correspondance 1903–1955, Albert Einstein, Michele Besso*, ed. Pierre Speziali (Paris, 1972), 114.

[270] Werner Heisenberg, 'Diskussion über Kausalität und Quantenmechanik', *Erkenntnis* 2 (1932), 184.

equate philosophical training lead many physicists to lapse easily into the metaphysics of academic philosophy.[271] Among the expressions of this view we may quote a letter from Hans Reichenbach to Pauli:

> I should be glad if the physicist would admit that the logician can help him to make his language clear. Such a contribution may appear insignificant as compared with mathematical results that help to find new observational data. But I think that logical clarification is a value in itself and should be welcome to a physicist to whom his science is more than a method of constructing industrial applications. An understanding of nature is inseparable from a logical analysis of the language in which we describe nature.[272]

Philipp Frank was particularly keen to link Bohr's interpretation of quantum physics to the positivism of the Vienna Circle. Frank believed that Bohr was a representative of the correct positivist scientific philosophy, despite the fact that he expressed himself somewhat unfortunately at times. He therefore saw it as his task to 'explain what Bohr actually meant'. When in a brief letter of reply Bohr objected that Frank had not interpreted him correctly, he defended himself by saying that Bohr's language often invited misunderstandings. At the creative stage it is possible that a physicist does not have time to worry about the formulation of his research in clear terminology, but once the results have been obtained it is every physicist's duty to express himself in a manner that makes it impossible to misuse his work. Here Frank especially warned against the possibility of a political misuse by certain national socialists. Only a consistent positivist or physicalist terminology in both physics and psychology can guard against such abuse. He expressed a wish that Bohr, too, who had been so important in the development of physics, would take part in the effort to bring this about. [273]

Bohr considered that it was both naive and unrealistic of the positivists to think that a precise language, free from contradictions, together with formal logic and a thorough analysis of concepts, was enough to solve every scientific problem. Heisenberg reports in *Physics and Beyond* a conversation with Bohr in 1952, which deals specifically with his attitude to the demand of the positivists for exact conceptual formation. Although this is a second-hand account, it agrees well with other information on Bohr's position in this respect. Bohr applauded the positivists' wish to adjust concepts to experience. This was naturally to be preferred to the adjustment, in earlier science, of experience to metaphysical and imprecise concepts. With this striving for

[271] Philipp Frank, 'Was bedeuten die gegenwärtigen physikalischen Theorien für die allgemeine Erkenntnistheorie?', *Erkenntnis* 1 (1930), 133.

[272] Reichenbach to Pauli, 4 Jun. 1947, *PLC*, (will appear in *PLC suppl.*).

[273] Philipp Frank to Niels Bohr, undated but probably 1935; *Niels Bohr Archive*, Copenhagen.

absolute clarity of concepts one avoids wasting energy on a mass of illusory problems. However he had no patience with the positivists' 'prohibition' of reflection on general questions where there are as yet no clear concepts. Moreover it has to be realized that when trying to understand quantum theory it is necessary to use as many methods of description as possible in order to get closer to its core. It is not precision but versatility in the conceptual apparatus that makes it possible to attain clarity. The strange relationships in quantum theory must be discussed in constantly changing terms and illuminated from different angles in order to make the listener aware of the apparent contradictions. Bohr underlined that quantum theory forms a wonderful example of how one may have understood something with perfect clarity but nevertheless realize that one can only talk of it in similes and images. The similes in this case are the concepts 'wave' and 'particle', which do not entirely represent reality. However, they are the only concepts we have for approaching the actual state of affairs. We cannot avoid contradictory concepts if we are to get closer to reality. On the other hand we must not ignore the fact that the innermost essence of reality is uniform, a uniformity that is impossible to express in our everyday language.[274] The reality that dwells in the deeps cannot be simply 'talked away' as the positivists try to do. The epistemological revolution of quantum physics is a revolution in the structure of thinking. It requires us to learn to see in a different manner, to approach the heart of a state of affairs from many perspectives.[275]

What then, is the position of Niels Bohr and the Copenhagen School with regard to 'positivism'? We have seen that the philosophies of Bohr and of the Copenhagen School show resemblances to a roughly defined positivism in their demand for verifiability and for the adjustment of concepts to observations. Seen superficially, therefore, Bohr joins the positivist tradition. The great difference, however, is that Bohr has made the actual act of observation the problem. I shall now attempt to show how intimately the so-called positivism of Bohr and the Copenhagen School is associated with a redefinition of the concept of experience. This can only be achieved by means of a closer examination of Bohr's philosophy.

Bohr's view of phenomena and everyday language and their relationship with a deeper-lying reality differs from that of a traditional positivist, in-

[274] It is not probable that Bohr saw this contrast between non-visual reality and everyday reality as immutable and determined in content. This contrast is only a particularly acute during periods of major change in the world picture. Pauli, at any rate, considered that the concept of visualization is relative and a question of adaptation and habit. Pauli, 'Background Physics', *PJL*, 185 (In the English translation the word 'illustrative' is used for *anschaulich*).

[275] Heisenberg, *Physics and Beyond*, 209ff.

strumentalist or phenomenalist. This is because Bohr speaks of a reality that exists beyond the phenomena.[276] The reality behind the phenomena cannot be observed or visualized and the classical concepts definitely cannot be used to describe it. Mathematical formalism is the nearest we can get to a description of this reality. Had Bohr been an instrumentalist, for example, he would not have opposed the proposal of Heisenberg and Pauli to break completely with the classical conceptual apparatus in microphysics. He would not have needed to demand a revision of the classical framework. It would have been enough to restrict the classical framework to the classical phenomena and to create an entirely new tool for quantum phenomena, as Pauli and Heisenberg wished. But Bohr considered that the complementarity perspective should *replace* the classical framework.

When Bohr says that the wave and the particle are different descriptions of the same object, he is naturally assuming that there is a real object behind the phenomena 'wave' and 'particle' which can only be described with the aid of these complementary symbolic images. A dyed-in-the-wool positivist would never be able to accept such an argument because any reference to a reality beyond the phenomena is regarded as metaphysics.

> Information regarding the behaviour of an atomic object obtained under definite experimental conditions may, however, according to a terminology often used in atomic physics, be adequately characterized as *complementary* to any information about the same object obtained by some other experimental arrangement excluding the fulfilment of the first conditions. Although such kinds of information cannot be combined into a single picture by means of ordinary concepts, they represent indeed equally essential aspects of any knowledge of the object in question which can be obtained in this domain.[277]

Descriptions of the behaviour of one and the same object under mutually exclusive experimental arrangements provide equally important but nevertheless incomplete illumination of the underlying object in each case. Together, however, they represent our combined experience of the object, in other words as complete information as is possible. The object at issue here is of course not the 'phenomenological object', as this is always identical with its expression. The wave and the particle are phenomena, 'the object', however, refers to the 'real' object which interacts with the experimental apparatus and which creates the physical phenomena. Bohr therefore presupposes the existence of an atomic system, concerning whose reality the physical phenomena give complementary information.

[276] Folse, 136–39.
[277] Bohr, 'Natural Philosophy and Human Cultures', 26.

In a letter to Bohr in 1953, Max Born suggested that it is the mathematical structures that constitute the reality behind the 'subjective' physical phenomena. Mathematics reproduces the hidden structures that form the core of reality. Moreover he identified these structures with the structures of pure thinking. Bohr replied that he could not understand what Born meant by 'the reality behind the phenomenon'.

> Indeed, it is difficult for me to associate any meaning with the question of what is behind the phenomena, beyond the correspondence features of the formalism which itself represents a mathematical generalization of the classical physical theories permitting, within its scope, predictions of all well defined observations which can be obtained by any conceivable experimental arrangement.[278]

In the next letter Max Born explained that he meant the mathematical 'invariants', i. e. those aspects of phenomena that are not dependent on how they are observed.

> . . . it is this which I would like to preserve as something beyond our direct experience. [–––] If one does not accept such a standpoint, it appears to me that one accepts a hyper-subjective or solipsistic standpoint, and that one resigns oneself to answering any question about why one is investigating the wor[l]d at all.[279]

In reply Bohr acknowledged that he had imagined Born was trying to reestablish a *visual* 'reality behind the phenomena'. Bohr entirely agreed with him that it is the abstract symbols of mathematical formalism that allow us to predict the phenomenological expression of the atomic objects. That is why mathematical formalism expresses what we know about the reality behind the phenomena.[280] Phenomenal reality is dependent on our everyday language and our everyday perception and therefore phenomenal reality is *symbolic*.[281] Bohr's concept of symbolic reality is directly related to the inadequacy of our visual concepts. Wave and particle are symbols because they give an incomplete picture of reality. They are symbols because they are 'clear' and therefore limited. Bohr's concept of symbolic reality is thus completely opposed to that of Pauli, who adopts Jung's (and Schopenhauer's) view of the symbol as inexhaustible and capable of uniting opposites. Concepts like 'the atom' and 'the wave function' (ψ) are truly symbolic because they unite the opposites of wave and particle. Pauli's view of the symbol is related to the mathematics underlying the phenomenona, rather than the phenomenon itself. Naturally Bohr also agreed that mathematics allows a contradiction-free description of

[278] Bohr to Max Born, 2 Mar. 1953 – BSC, mf. 27. *AHQP*.
[279] Max Born to Bohr, 10 Mar. 1953 – BSC, mf. 27. *AHQP*, Cf Born, 'Symbol and Reality', *Dialectica* 20 (1966), 155.
[280] Folse, 249. See also Bohr to Max Born, 26 Mar. 1953 – BSC, mf. 27. *AHQP*.
[281] Bohr, 'Introductory Survey', 295–296. Also cf. Folse, 246.

the phenomenon, but he did not use the word *symbolic* to describe the kind of knowledge that mathematics represents.[282]

We can no more label Pauli a positivist than we can Bohr. As I have shown, Pauli certainly began with a more operationalist and 'phenomenological' attitude than Bohr, an attitude that carried the strong imprint of Mach's positivistic conceptual criticism. Bohr, who could not relinquish classical and visual continuity, preferred to look for the solution in a dualistic thinking that bore marks of the Danish philosophical tradition. Although Pauli was influenced by Mach's conceptual criticism at an early stage, there is no reason to assume that Pauli ever embraced positivist philosophy without reservation, whether in Mach's form or in that of the Vienna Circle or in the shape of analytic philosophy. The main reason for this is that positivism represents a philosophical system or programme. Neither Bohr nor Pauli was a supporter of such a programme, even if their scientific method shows certain similarities with positivist thinking. The 'positivist' features, which we recognize in the representatives of the Copenhagen School, have more in common with the legacy of Mach and James than with the newer type of positivism represented by the Vienna Circle. To them all, however, the central theme was the return to what is directly given to man, away from speculation on the innermost essence of reality. The 'directly given' is, in most cases, identified with what we call 'experience'. Many believed that with these words they had exhausted the problem and laid down a reliable starting point. But what is meant by experience? We shall see that it is often on this point that differences of opinion arise concerning what may be considered a legitimate scientific study and what may not.

A consistent feature of Pauli was his dislike of ready-made, cast-iron explanations of the world and philosophical programmes in the form of various 'isms'. To Ralf Kronig, Pauli writes in 1934:

> I prefer spiritual positions which end in -logy; those ending in -sophy are worse and those ending in -ism worst of all. In any case no physical theory at all is 'logically demonstrable'.[283]

Preconceived opinions and ready-made solutions in physics and elsewhere he referred to derisively as 'confessions'. The neopositivist Rudolf Carnap's *Der Logische Aufbau der Welt* (1928) contains an ardent call to clear, non-metaphysical philosophy and science. But in Pauli's copy of the book we find

[282] This might be due to Bohr's 'unmathematical' thinking. See Pais, Abraham, *Niels Bohr's Times, in Physics, Philosophy, and Polity* (Oxford, 1991), 178–179.

[283] Pauli to Kronig, 3 Aug. 1934 [380], *PLC* II, 341 note.

the note: *Belief* in clarity is also an expression of metaphysics and religion![284] When in 1930 Moritz Schlick sent Pauli the manifesto of the newly founded Vienna Circle, he replied: 'I found the writings you sent me about the newly founded Vienna confession very interesting, but I don't feel that I quite belong to it.'[285] What particularly irritated him about the Vienna Circle positivists was that he felt they were 'lazy': they stopped thinking just when the problems were getting interesting.[286] Carnap's ideas that every physical object can be traced back to a psychic one and vice versa, and that all mental processes have parallel processes in the central nervous system were, to Pauli, 'lazy' positions which did not explain anything.[287]

Pauli himself dubbed his position 'of anti-metaphysical origin' (i. e. demand for empirical or logical verifiability) but most of all he prided himself on being a 'heretic' not bowing down to any God, authority or 'ism'.[288] In a highly interesting correspondence with the philosopher Franz Kröner in the 1950s Pauli is forced to clarify his position towards labels like 'positivism', 'realism', 'idealism', 'phenomenalism' and 'metaphysics'. Their discussion sets off in 1953 with Pauli opposing Kröner's description of quantum physics as tied to 'a restrictive philosophy in the spirit of positivism'.[289] The attempt to wed the development of science and quantum physics to an all-prevailing positivistic attitude was ridiculous to Pauli, and as fanciful as a fairytale. He of course knew about Pascual Jordan's attempt to link 'radical' positivism to depth psychology and parapsychology (see below) but he states that he could not make any sense of the term 'twentieth-century positivism' or 'neopositivism'.[290] At first he identified positivism solely with August Comte, whose philosophy had strong links to the 'empiricism' and 'sensualism' of the nineteenth century. He stated that almost nothing of this position remained in modern physics. He proposed to drop the term 'positivism' entirely, also because he thought it slightly ridiculous: how can there be a 'Positivism' when there is

[284] Rudolf Carnap, *Der logische Aufbau der Welt* (Berlin, 1928), V. The book is in 'La Salle Pauli', CERN, Wissenschaftliches, No. 297. He has written: 'The fact of pursuing science at all cannot be rationally justified! The rules [...] of the game added to the theses, the purposes (through success) [...] added to the rules of the game [...]. Belief in clarity is itself metaphysics, religion!' [Original: Daß man überhaupt Wissenschaft treibt, läßt sich nicht rational rechtfertigen! Die Thesen mir beigegebenen Spielregeln, die Spielregeln mir beigegebenen Zielen (durch den Erfolg). Glaube an Klarheit ist selbst Metaphysik, Religion.] It is difficult to decide whether Pauli wrote these comments as early as 1928.

[285] Pauli to Schlick, 10 Jun. 1930 [246], *PLC* II, 15.

[286] Pauli to Schlick, 5 Feb. 1931 [265], ibid., 56.

[287] Carnap, 77–79. In his copy of the book Pauli has written 'lazy!' in the margin. 'Salle Pauli', CERN, Wissenschaftliches, No. 297.

[288] Pauli to von Franz, 17 February 1955 [2019], PLC IV/3.

[289] Pauli to Kröner, 29 June 1953 [1593], *PLC IV/2*.

[290] This is a bit curious as he only a few month earlier identified Mach's approach with positivism in a letter to Jung. See Pauli to Jung, 31 Mars 1953 [60P], *PLJ*.

no 'Negativism' he asks spitefully, while declaring that he always thinks in opposites.[291]

In 1955 Pauli encountered a definition of positivism in a book by the philosopher E.A. Burtt (recommended to him by Kröner). There a positivist is described as a careful person, holding back and refraining from last judgements on reality and keeping to what is proven and certain. Pauli is amused by this 'negative' definition of positivism as a kind of resignation and 'abstinence' from judgement, a position that recommends a strict diet when it comes to speculation and systematisation. Pauli clearly sympathizes with this approach when applied in moderation, although he does not find the label 'positivism' fitting. Nevertheless it has to be supplemented with a metaphysical outlook; metaphysics is needed as a conscious *attempt* to make preliminary statements about meaning and ethics that could and should have an influence on the scope of natural science. This kind of metaphysics was justified according to Pauli, as well as the metaphysics of making hypothetical statements that go beyond the purely factual. The metaphysics he could not accept was statements based on 'last truths' proclaimed by authority and power.[292]

In 1956 he was willing to accept the term 'positivism' not as a philosophical programme but as *property* of a theory. In this sense a 'positivistic' approach consists in eliminating outdated concepts from a theory (like the concept of ether in physics); 'idealistic' means augmenting experiential phenomena with ideas in order to reach a more complete theory (such as the interpretation of the ψ-function as probability amplitude); a theory is 'realistic' when it posits an objective, collectively valid existence beyond arbitrary human influence (i. e. the concept of 'state' in quantum physics); 'phenomenalistic' is an approach that ties together two complementary pieces of information about the same object matter, such as the case in quantum mechanics where the (idealized) results of the measurements are linked to the mathematical formalism so that no logical contradiction arises (i. e. Bohr's concept of 'indivisible phenomena'). This clarifying discussion with Kröner leads Pauli to retract the concept 'antinomic', an epithet that he had given to Bohr's way of thinking a few years earlier when he called him 'a master of antinomic thinking', teaching Pauli 'that every true philosophy must actually start off with a paradox'.[293] Now he realizes that the term implies a logical contradiction, which is not the case with Bohr's theory of complementarity. Instead

[291] Pauli to Kröner, 29 June 1953 [1593], 20 October 1953 [1657], 27 July 1954 [1853], 16 November 1954 [1921], *PLC IV/2*.

[292] Pauli to Kröner, 16 January 1955 [1979] + appendix, PLC IV/3. See also E.A. Burtt, *The Metaphysical Foundations of Modern Science* (New York, 1924/54).

[293] Pauli to Jung, 27 February 1953 [58P], *PJL*, 94.

Pauli uses the term 'phenomenalistic' for the approach that characterizes both quantum physics and depth psychology, i. e. accepting the necessity for opposite concepts and representations in science that exclude simultaneous use, which are needed in order to reach a complete picture of the known facts.[294]

Pauli himself saw the guiding star of his scientific activity as something that he called physical feeling or sensibility (*physikalisches Gefühl*). This physical feeling is anything but codifiable in logical or conceptual definitions.[295] Hypotheses that are based on this 'physical feeling' cannot be proved by logical evidence. Nor is this feeling based first and foremost on measurable and observable units. Rather it appears to have a mathematical foundation. In 1955 Pauli writes to Erwin Schrödinger:

2. In judging a physical theory its logical and mathematical structure is (at least) as important as its relationship to empirical knowledge (to me personally the former is even more important).
3. If I reflect on *where* a theory is in need of improvement, I *never* start by considering measurability, but look at those conclusions of the theory where the mathematics *is not right* (such as infinity or divergence). Naturally 'our objective is the general laws' (*with this* I am 100 % in agreement).
   That despite these theses I reach a different judgement of quantum physics from yours is perhaps hard for you to understand. Perhaps this is ultimately due to my differing view *of the position of man* (i. e. in physics: the observer) *in nature*.[296]

Pauli emphasizes that the mathematical aspect of a theory is more important to him than its empirical foundation. On the other hand it must be remembered that he made a sharp distinction between formal mathematics and the mathematics that is used in theoretical physics. He was quite critical of pure mathematics, disconnected from empirical knowledge. Pauli was always criticizing theories for lacking adequate physical anchorage: 'the mathematics is right, but what does it mean physically?' was one of his most frequent comments.[297] The logical and mathematical thinking that Pauli adopted could not be identified with that of formal logic. Mathematics must always refer to an empirical or everyday reality and not operate in a formal self-referring world.[298] He was not sympathetic to the positivists' view of mathematics as

[294] Pauli to Kröner, 28 November 1956 [2404], 30 November 1956 [2406], PLC IV/3. The term phenomenalistic is not to be identified with the philosophical position of phenomenalism which reduces all experience to sense data. It obviously corresponds to the phenomenological method. See footnote 264.

[295] Pauli to Bohr, 31 Dec. 1924 [79], *PLC* I, 197; also Pauli to Bohr, 2 Oct. 1924 [66], ibid., 164.

[296] Pauli to Schrödinger, 27 Jan. 1955 [1992], *PLC IV/3*. Cf Meyenn, 'Ist die Quantentheorie milieubedingt?', 3.

[297] Pauli to Fierz, 30 Mar. 1947 [877], *PLC* III, 435.

[298] Wolfgang Pauli, 'Matter' (1954), *Writings on Physics and Philosophy*, 28.

a tautological system. On the subject of analytic philosophy he says to Moritz Schlick in 1931:

> I cannot get accustomed to the orientation of Wittgenstein at all (transfer of the logical methods of Hilbert and others from mathematics to the sciences); I do not see the productiveness of these methods.[299]

A few years later he remarks, concerning the method of symbolic logic, that he is 'very much impressed by its complete failure [...] to enlighten the lack of contradiction [...] in mathematics.'[300] He had discussed the matter with Gödel and von Neumann and they had agreed with him that this method could never solve the basic issue of freedom from contradiction. Pauli considered that the mathematicians had failed in their efforts to establish the foundations of mathematics largely because of their entirely formal approach. In a letter to Jung in 1950 he describes the situation in mathematics research as chaotic:

> In connection with this, it should be noted that the specialized field 'Fundamentals of Mathematics' is in a state of great confusion at the moment as a result of a large-scale undertaking to deal with these questions, an endeavour that failed because it was one-sided and divorced from nature. In this field of research into the fundamentals of mathematics, the 'basis of mathematical probability calculus' marks a particular low point. After reading an article on this subject in a journal, I was dismayed at the differences of opinion, and later I heard that, whenever possible, experts avoid discussing this subject on the grounds that they know they will not be able to agree![301]

What is typical of Pauli, as we shall see, is his *symmetrical* approach in almost every area. We see this approach in his search for a symmetrical position between empirical data and mathematics, theory and experiment, phenomenalism and realism, inner and outer (observer and observed), religion and science.[302]

[299] Pauli to Schlick, 5 Feb. 1931 [265], *PLC* II, 58.

[300] Pauli to Carl Eckart, 11 February 1936 in 'Paulis philosophische Auffassungen' in *PLC IV/2*,XII.

[301] Pauli to Jung, 12 Dec. 1950 [47P], *PJL*, 64. Cf the pronouncement of the mathematician Herman Weyl: 'The ultimate foundations and the ultimate meaning of mathematics remain an open problem; we do not know in what direction it will find its solution, nor even whether a final objective answer can be expected at all.', Weyl, 219.

[302] Wolfgang Pauli, 'Theory and Experiment' (1952), *Writings on Physics and Philosophy*, 125.

The Copenhagen School and Psychology

With the crisis of physics,interest in epistemological and psychological questions grew among many theoretical physicists. This interest was particularly marked in the circle around Niels Bohr.Some believe that it was the empirical discoveries themselves that forced Bohr to move from a purely scientific analysis to an increasingly epistemological and psychological one.[303] Others believe that Bohr had always had an interest in psychology and epistemologyand that this pervaded all his thinking about physics.[304] One problem in this context is the boundary between psychologyand epistemology. Psychology is of course a much broader concept than epistemology. Epistemology is defined as philosophical investigation of human knowledge, its conditions, possibilities, nature and boundaries. Psychology may also deal with the conditions of knowledge, but it is mainly concerned with other things such as the conditions of perception, behavioural research, studies of the significance of inheritance and environment, psychological health and ill health, and more. It is obvious that for my main characters the focus lies on epistemology rather than on psychology in its broader sense. Their frequent references to psychology is linked to a specific intellectual tradition prevalent at the time.

Some philosophical schools consider that the basis of knowledge lies in reason, which is seen as a something independent of the psyche. Others, on the other hand, consider that all epistemology, and all philosophy as well, must be based on psychology. The philosophers of the first kind usually refer to this school of thought as *psychologism*.Another difference is that epistemology as a philosophical subject tries to lay down normative criteria concerning validation of knowledge. Psychology on the other hand often attempts to be purely descriptive. We see therefore that there are at least two traditions concerning the relationship between psychology and epistemology. One treats epistemology as a branch of philosophy, distinct from psychology, to the other epistemology is a branch of psychology. In our context we shall come almost exclusively into contact with that intellectual tradition which regards epistemology as a branch of psychology, or at least as very closely related to it. This tradition embraces William James,Harald Høffding,and Ernst Mach,all of whom play a leading part in shaping the view of my main characters on epistemology. It is a position to be found not least in Niels Bohr, who asserted that it must not be forgotten that epistemological and psychological analysis are two inseparable entities.[305]

[303]Miller, 'Visualization', 95.

[304]Feuer, 126 f.; Rosenfeld, 'Niels Bohr's Contribution to Epistemology', 49.

[305]Niels Bohr, 'Analysis and Synthesis in Science', *International Encyclopedia of Unified Science* I (Chicago, 1938), 28.

Before we take a closer look at Bohr's affiliation with psychology, I will mention another attempt to connect the development of quantum physics with that of depth psychology. It is the case of Pascual Jordan,colleague of Pauli, Heisenbergand Bohr and co-creator of quantum mechanics.

Pascual Jordan: Radical Positivism, Psychology and Parapsychology

Pascual Jordan had a strong interest in the implications of modern physics for epistemology, psychology, biology and parapsychology. He claimed that he was directly following Bohr's and Pauli's line of reasoning when he ventured to speculate about these matters. He also claimed that he was following the consequences of positivism, while the 'true' positivists, i. e. the Vienna Circle, rejected his position and accused him of a metaphysical use of language. Jordan was convinced that positivist thinking could revolutionize our picture of the world and link areas of knowledge that had previously been separate. It would even be possible to integrate knowledge that had once been dismissed as superstition. Jordan's use of the concept of positivism reveals the problems inherent in the seemingly simple wish to 'get back to experience'.

Jordan took a particular interest in Freudian psychoanalysis and in 1947 he published a book entitled *Verdrängung und Komplementarität*, in which he compared Freud's concept of repression and Bohr's concept of complementarity. In this book he also touches on the subject of parapsychology.[306] Back in 1934 Jordan had written an article entitled 'Positivistische Bemerkungen über die Parapsychischen Erscheinungen' [Positivistic Remarks on Parapsychology].[307] It is worthy of note that he was confident enough to send an article on such a subject to one of the largest and most respected scientific journals of the day, *Die Naturwissenschaften*, for publication. The editor was somewhat perplexed and sent the article to Pauli for an opinion. Pauli recommended Jordan to seek a different forum for his work and suggested that he contact Jung. This led to a correspondence between Jordan and Jung that was primarily on the subject of parapsychology.[308] Not until two years later was Jordan's article published in Jung's *Zentralblatt für Psychotherapie*.

[306] Pascual Jordan, *Verdrängung und Komplementarität: Eine philosophische Untersuchung* (Hamburg, 1947).

[307] Idem., 'Positivistische Bemerkungen über die Parapsychischen Erscheinungen', *Zentralblatt für Psychotherapie* IX (1936). See also Pauli to Jung, 26 Oct. 1934 [7P], *PJL*,5.

[308] Pauli to Jung, 26 Oct. 1934 [7P], *PJL*, 5; Pauli to Jordan, 22 Nov. 1947 [918]; idem, 21 Feb. 1948 [939]; idem, 23 Mar. 1948 [942], *PLC* III, 480, 510, 516; and C.G. Jung: Briefwechsel mit Pascual Jordan (1934–1949), *WHS*, Hs 1056.

Pauli was very cautious in his attitude to Jordan and his ideas. He had no wish to be officially linked with an interest in parapsychology. He was much discomfited by the fact that Jordan had referred to him in connection with parapsychology and spiritualism. At the beginning of his book Jordan writes that in a letter to him twelve years ago (i. e. about 1934) Pauli had said that he would like to see more research into the application of the principle of complementarity in depth psychology and parapsychology.[309] Angrily Pauli writes to Jordan that he does not wish to be cited in such contexts and adds sarcastically that he is not surprised that people who sit for long enough in a dark room finally begin to see strange things.[310] He did not mind facilitating contact between Jung and Jordan, so that they could discuss their common interest in parapsychology together. He himself however did not believe that parapsychological phenomena could ever be proved.[311]

In this particular case we see in Pauli a clear division between an official opinion and his unofficial views. Pauli was in actual fact much more interested in parapsychology than he made himself out to be in his letters to Jordan. As we shall see later, this interest especially concerned Jung's concept of synchronicity. All the same, he did not want this to be spread as official. He felt that his speculations in this area were still very tentative ones and he was anxious to proceed carefully without losing his critical view. He saw Jordan, on the other hand, as uncritical and far too inclined to publish half-baked ideas and drafts. When he did this, Jordan usually included references to his colleagues and quoted them freely. Pauli did not therefore feel free to discuss these questions with him properly, being far too much afraid of 'being published by Jordan'.[312] Pauli's attitude to parapsychology relented in the 1950s, when J.B. Rhine and the Englishmen Soal and Bateman tried to carry out scientifically monitored parapsychological experiments. Pauli considered that their *Modern Experiments in Telepathy* was of a high scientific standard.[313] Now Pauli was bold enough to acknowledge his interest in parapsychology more openly and to defend it against his colleagues.[314]

As Pascual Jordan ventured into speculations about the implications of the epistemological revolution in modern physics for biology and psychology,

[309] Jordan, Verdrängung und Komplementarität, 9.

[310] Cf. e.g. Pauli to Jordan, 22 Nov. 1947 [918], *PLC* III, 480.

[311] Pauli to Jordan, 21 Feb. 1948 [939], *PLC* III, 510.

[312] Pauli to Jordan, 23 Mar. 1948 [942], ibid., 517.

[313] Soal & Bateman, *Modern Experiments in Telepathy* (London, 1954). In 1978, however, B. Marwick showed that Soal had manipulated his data. Ulrich Müller-Herold, 'Vom Sinn im Zufall', *Der Pauli-Jung Dialog*, 173.

[314] See, for example, Pauli to Kronig, 5 Apr. 1955 [2061], PLC IV/3, or Pauli to Weisskopf, 2 Nov. 1954 [1907], *PLC IV/2*.

he explicitly referred to Bohr. But Jordan's philosophical position can also be traced to quite different roots. When Jordan began to include subjects that traditionally lie outside the boundaries of science, such as the study of parapsychological phenomena, he knew that he was going beyond what Bohr could accept. However he considered that the new perspectives which modern physics and Bohr's principle of complementarity had opened were consistent with an interest in such fields. Jordan allegedly adopted the philosophies of Mach and Hume, which he saw as fundamental to all scientific thought. In an article in *Die Naturwissenschaften* in 1932 he did not yet use the term 'positivism', but he underlined Hume's insight that it was necessary to return to the observable in order to give concepts a scientific precision. The primary scientific concepts must be directly relatable to observations. In 1934 he wrote an article in the Vienna Circle journal *Erkenntnis*, in which he expressed his delight at being able to present his ideas in a forum which saw as its mission the development of the epistemological viewpoint of Ernst Mach. Jordan said that he fully endorsed the ideas expressed in the earlier essays of Hans Reichenbach and Rudolf Carnap. The epistemological principle that Jordan propounds is one that we recognize from the logical positivists:

> We wish to put forward an *epistemological proposition*, which we have repeatedly used earlier without specifically expressing it: if a statement is of such a nature that it cannot be shown by any means at all (by experiment or by logical/mathematical analysis) either to be right or to be wrong, *then this statement is meaningless*. [–––] Equally it is epistemologically impossible to say that an electron, although one cannot *observe* definite values in space and velocity in it, nevertheless can or must '*possess*' defined place and defined velocity; or that an exactly causal determination can '*exist*', *without being demonstrable*.[315]

Quite simply, Jordan extrapolates the positivist position that scientific knowledge is based on observation. In microphysics all observation means an intervention or disturbance of the observed, therefore it can also be said to *create* the observed facts to a certain extent. Atomic physics is hence not a description of objective conditions but rather a description of the regularities of the processes of observation. This contributes to the modification of the old absolute division between objective observation and subjective experience. For this reason the division between external and internal reality is no longer equally absolute.

Jordan compared the situation in psychology with the situation in microphysics in the same way as Bohr did: when one tries by introspection to

[315] Pascual Jordan, 'Quantenphysikalische Bemerkungen zur Biologie und Psychologie', *Erkenntnis* 4 (1934), 230–31.

discover something about one's own inner world, the process of observation exercises a profound influence on the mental reactions which one wanted to observe – in other words the observation alters the observed processes. Jordan particularly emphasized that a fully-fledged positivism, a so-called *radical positivism*, draws together what we call the external and the internal world, simply because it bases its knowledge on experience, not on the existence of material objects. Experience is the irrefutable link between the 'subjective' internal world and the 'objective' external world. There is no absolute difference between these worlds, only a gradual sliding transition.[316] These are views that we recognize from Ernst Mach and William James But although the positivists of the Vienna Circle claimed these two as their models, they could not accept Jordan's application of these ideas.

Edgar Zilsel attacked Jordan's analogy between the situation in modern physics and in psychology. He found the self-observation problem in psychology in no way comparable with that in quantum physics. Did psychology have a quantitative uncertainty relationship comparable with the limit represented by Planck's constant? Nor is it at all remarkable that attention to a feeling disturbs self-observation; that is of course why analysis by an external agent is necessary. But this has nothing at all to do with the possibility of anticipating spiritual processes.[317] Otto Neurath felt that Jordan was employing vague analogies and metaphysical language in an attempt to find evidence for old scholastic philosophical theses by drawing on the pure, clear quantum theory. A quotation such as: 'The *revolutionary character* of the quantum theory shows itself far beyond physics in entirely novel perspectives, which it contributes to the discussion of the deepest problems of philosophy, of freedom of will and of the relationship between subject and object, and in the far-reaching stimulus which it has to offer biology and psychology' was according to Neurath proof of Jordan's uncritical and metaphysical approach.[318] As long as the biological argument does not show how quantum mechanics can assist in improving prognostic methods in the biological field, the whole argument is useless.

> It is to anyone who is concerned with the rejection of metaphysical fabrications an example of a very uncritical attitude, if a writer speaks of the 'relationship of subject and object' with the same lack of inhibition with which the 'relationship

[316] Idem, 'Über den positivistischen Begriff der Wirklichkeit', *Die Naturwissenschaften* 22 (1934), 488–489.

[317] Edgar Zilsel, 'P. Jordans Versuch, den Vitalismus quantenmechanisch zu retten', *Erkenntnis* 5 (1935), 60.

[318] Pascual Jordan, 'Die Quantenmechanik und die Grundprobleme der Biologie und Psychologie', *Die Naturwissenschaften* 20 (1932), 821.

> of magnet and piece of iron' are discussed. [–––] *the method employed by Jordan, of linking good modern physics with antiquated metaphysics, is not conducive to the clarification for which we are searching.*[319]

Actually Jordan's assertion does not differ so very much from Bohr's way of expressing himself regarding the relationship between quantum physics, psychology and biology.[320] Just like Bohr, Jordan argued that the phenomenon of 'life' stands in an exclusive relationship with a definition of the basic physical components of life, as such an accurate definition requires one to kill the life or destroy the vital function that one wishes to study. At the same time Jordan put forward a theory that the acausal component, which in physics is eliminated with the aid of the statistical method, is instead *strengthened* in the organic sphere. To understand the stability of the organic system other explanatory models are required, in which teleology must be an important component.[321] Jordan was vigorously attacked for these pronouncements by the Vienna positivists, who accused him, among other things, of vitalism. In content, however, what he said was not essentially different from Bohr's more cautious formulations. The real differences between Bohr's position and Jordan's were of a different nature.

Bohr was first and foremost critical of Jordan's efforts to apply the new epistemological situation in quantum physics to an understanding of parapsychological phenomena as such, which he saw as merely illusions. The phenomena should therefore not be taken seriously. On this point his opinion was also in conflict with Pauli's more positive interest in parapsychology.

> The most recent attempt of Jordan while continuing such deliberations to find room even for the so-called parapsychological events, would seem in my opinion quite misplaced, because it must be not only in stark contrast to the strictly physical description of the behaviour of the organism but also incompatible with a rational pursuit of psychophysical parallelism. I am convinced that the parapsychological events are an illusion, which is also conjured up by the sources of error in the observation and interpretation of psychological experiences.[322]

The attitude of the Vienna positivists to modern physics and its philosophical implications therefore presents a somewhat fragmented picture: on the one hand they wanted to show modern physics as a confirmation of the fertility of their own philosophy. They wanted to show that modern physics was a direct result of the application of positivist principles and therefore to claim

[319] Otto Neurath, 'Jordan, Quantentheorie und Willensfreiheit', *Erkenntnis* 5 (1935), 181.
[320] Bohr, 'Biology and Atomic Physics', *Atomic Physics and Human Knowledge* (New York, 1958), 20–22.
[321] Jordan, 'Die Quantenmechanik und die Grundprobleme der Biologie und Psychologie', 820–21.
[322] Bohr to Professor Meyerhof, 5 Sep. 1936 – BSC, mf. 23. AHQP.

pioneers such as Heisenberg and Bohr as adherents of a positivist philosophy. On the other hand they could not accept the philosophy of complementarity that developed in conjunction with the very application of the 'positivist' principle. They tried to lay down criteria for deciding which pronouncements could be regarded as scientific and were guided in this process increasingly by rigorous demands for a logically non-contradictory language. With this they ended up farther and farther from Bohr's perspective, which stressed the ambiguity of language.[323]

Pascual Jordan draws upon Ernst Mach in order to develop what he called a *radical positivism*. In the preface to his *Verdrängung und Komplementarität* he said that he wanted to show that the parapsychological phenomena would lose much of their apparent incomprehensibility if they were only considered in the light of positivist epistemology.[324] In his article on parapsychology he argued as follows: positivism states that all scientific knowledge must be based on our immediate experiences and impressions. We must get away from the traditional metaphysical view that there is a real external world existing independently of the constitution of the mind (i. e. of the conscious and the unconscious). Radical positivism follows a strict empiricism and positivism in that it considers that the aim ought to be to order coherently and describe all experiential facts, without drawing any speculative conclusions from them. It seeks also to adhere to the positivist criterion that pronouncements and questions are pointless if they cannot demonstrate verifiable or refutable connections and regularities in the observation material.

In the earlier scientific view of the world it was taken for granted that our experiences were based on impressions from the objective or 'real' external world. This opinion was in turn based on the conviction that it is possible to attain a total objectivity with the physical laws, laws which apply irrespective of whether we observe them or not. With quantum physics, in which every observation constitutes an interaction between subject and object, the sharp distinction between 'objective external world' and 'subjective internal world' has become a problem. An 'objective sensory impression' and a 'subjective hallucination' can no longer be regarded as intrinsically different things, but have to be seen as being on a continuum with various intermediate stages. Such a stage might be that of mass hallucination or selective vision conditioned by cultural prejudices, in other words intersubjectivity. The objectivity question can no longer be decided with reference to the existence of an independent 'reality'; truth and objectivity are rather a matter of experiential equivalents.

[323] Heisenberg, *Physics and Beyond*, 209 f.
[324] Jordan, *Verdrängung und Komplementarität*, 9.

The ultimate difference between pure sensory impressions and hallucinations is that the former represent a 'mass equivalence' (*Massen-Äquivalenz*), and have a social significance, whereas the latter have an individual or private meaning.

Radical positivism sees no reason for science to confine itself to the study and use of the experiences that show the greatest 'mass equivalence'. Describing and arranging other types of experience, such as internal perceptions or paranormal experiences, has an equally important place in science – as long as we are content with collecting and describing them. Jordan considered that developments in quantum mechanics had led to a changed view of science or an expanded worldview, in which certain areas of human experience cannot be ruled out in advance. If the study of paranormal experiences shows equivalences, these must have the same scientific value as the 'social' universally valid equivalences that lead us to speak of the real objects of the physical world. In *Verdrängung und Komplementarität* Jordan reasons in a similar manner:

> . . . for we are accustomed in scientific deliberations to be counting two *fictions* as facts: the fiction of a real external world, independent of all perceptual processes, and the fiction of human intelligences, which are capable of infallible observation of this real external world without being subject to the laws of psychology and the intervention of the unconscious. But in fact we are swimming in a sea of psychology – of dreams, suggestions, complexes – and what forms the factual basis of that fiction of infallible perception has the significance of no more than a few thin reefs of coral in the middle of this sea.[325]

The building blocks of the physical worldview is the result of special experiences: observations, measurements, and experiments. Admittedly these experiences are important, but they nevertheless represent only a small portion of our experiential world. The remainder, including what we call dreams, hallucinations, suggestions, fears and so on, is of the same rank *as experiences* as the laboratory experiences. According to Jordan new physics has taught us that physics, too, depends on psychology. In order to be able to get any further in the development of knowledge and avoid finding ourselves in a state of hopeless confusion, we have been obliged to take a decisive methodological step. Returning to immediate experimental data was the prerequisite for the development of the theory of relativity and quantum theory.[326] With a consistent application of positivism we see that we have to put our experience in the centre. A direct consequence of this is that we have to go deeper in

[325] Ibid., 70–71.
[326] Ibid., 23.

our research into what our experience consists of and how the cognitive process works, in other words how our psyche works. We see in Jordan a more explicit version of what was already intimated by Bohr: a reconnection with psychology, with the conditions of human knowledge.

> Whereas, then, the usual view is that physics is the all-embracing science with psychology as a very special section of it [. . .], the positivist conception, strictly applied [radical positivism, author's note] quite conversely sees psychology as the all-embracing science, and physics as a very small section of it, namely the one which devotes itself to the experience of people in laboratories, observatories etc.[327]

Jordan believed that Freud's concept of 'repression' and Bohr's concept of 'complementarity' were equivalents, and indicated a corresponding expansion of the worldview in the two sciences. Physics has expanded its worldview by including the subject as a factor in the measuring situation and psychology has expanded the view of man by expanding the human psyche from pure consciousness to an inclusion of an unconscious reality which is as supraindividual (i. e. collective, shared) to all individuals as our shared external world.[328]

> It means simply the logical application of our conviction of the fundamentally equal validity of the conscious and the unconscious, of dream and waking experience, if we make the assumption that even the conceptual and experiential contents of the unconscious – and indeed the individual, concrete contents themselves, not only the conceptual motives taking shape in them -, have a supraindividual, collective meaning similar to the 'perceptions' of the conscious.[329]
>
> Just as in physics the facts discovered in recent decades have necessitated fundamental extension of the previous physical world picture, so with respect to the psychology of the unconscious, especially parapsychology, fundamental extension of the scientific world picture is unavoidable. It results in a similar manner inductively from the analysis of empirical data and deductively from the logical continuation of the epistemological conception of positivism, linked with the fundamental findings of quantum physics and psychoanalysis. It leads us towards the insight that physical space contains only one section of experiential, experienceable reality – namely the collective space of consciousness, to which are opposed the spaces of the collective unconscious in complementary equivalence.[330]

The example he uses in order to illustrate the corresponding nature of the two concepts complementarity and repression is that of a man who is prevented

[327] Ibid., 71.

[328] It may be noted that even Einstein, though rather sceptical of Freud's theories, found some validity in his theory of repression. See Erik H. Erikson, 'Psychoanalytic Reflections on Einstein's Centenary', *Albert Einstein: Historical and Cultural Perspectives*, eds., Holton & Elkana, (Princeton, 1982), 167.

[329] Jordan, *Verdrängung und Komplementarität*, 79.

[330] Ibid., 80.

from doing something he had planned by various obstacles: forgetfulness, error and unforeseen events. Not until he goes to a psychoanalyst does he become aware that he has been harbouring various unconscious intentions, which are in conflict with his original plans. Only by his becoming aware of these unconscious intentions and complexes can they be dissolved and cease to exist. Just as in quantum mechanics, the observed system (i. e. the unconscious) is altered by observation. Another example given by Jordan is the case of split personality split personality means that one person shows two distinct, totally different personalities. A doctor can never observe these two personalities at the same time; the different personalities are mutually exclusive. But the doctor can, if he observes the different personalities, obtain complementary information on the whole underlying personality structure. This corresponds to the situation in quantum mechanics, in which one cannot observe the electron as 'Mr Wave and Mr Particle' at the same time, but they both represent complementary information on the nature of the electron as a whole.[331]

Many have depicted Jordan's attempt to find similarities between psychology and physics as very far-fetched. Heilbron calls it a misuse of Bohr's physics designed to raise personal psychological problems to the rank of the fundamental problems of quantum physics.[332] Nevertheless there are similarities between Bohr's concept of complementarity and the passage in William James where he describes the split personality. The similarity is so striking that some believe that this must be where Bohr's concept of complementarity was obtained.

[331] Ibid., 44–45; and Jordan, 'Reflections on Parapsychology, Psychoanalysis, and Atomic Physics', *The Journal of Parapsychology* XV (March 1951), 278–281.
[332] Heilbron, 'The Earliest Missionaries', 226.

Niels Bohr and Psychology

When Niels Bohr drew the analogy between the observation problem in quantum physics and similar problems in psychology he referred to William James' exposition of the subject. In 1936 Bohr wrote to Meyerhof:

> As far as my comments on the psychic problems are concerned, it is first and foremost simply a matter of the purely formal analogy between, as I see it, the difficulty, acknowledged by all psychologists and so graphically presented by W. James, of observation and analysis of psychic experiences and the state of affairs in atomic physics.[333]

The problem of observation in psychology to which Bohr refers is the difficulty of distinguishing between subject and object in the analysis and observation of psychic experiences. William James had devoted a great deal of energy to clarifying this problem. James laid down that psychology had to be regarded as a science in that the psychologist considers consciousness – including his own – and its products as objects of observation. The psychologist stands outside the mental state even when he is describing his own. By describing a state one automatically steps outside it and the state becomes the object one is studying. The relationship between 'consciousness' and 'its object' is described as a 'relation of knowing'. The relation was to James as real as the objects that the relation joins together. The specific knowledge situation faced by the psychologist is based on a non-reducible dualism that always assumes a 'mind knowing' and the actual 'thing known'. To a psychologist, however, it is both the mind knowing and the thing known that constitute the object of study. The psychologist must be aware of this in order not to confuse his own knowing with what he is going to study. Knowledge is knowledge not only of an object, but also equally of the conditions under which the knowledge is obtained. Knowledge of an object can therefore never be static, because the circumstances of a study can never be exactly the same.

Although there are obvious similarities between Bohr's emphasis on the difficulties of the observation process and William James' analysis of the observation problem in psychology, it is open to dispute how early Bohr came into contact with James. The question is whether James' thinking influenced

[333] Bohr to Professor Meyerhof, 5 Sep. 1936 – BSC, mf. 23. AHQP.

Bohr before the formulation of the complementarity principle or whether Bohr only discovered the striking resemblance between James' ideas and his own later.[334] Bohr's colleague Léon Rosenfeld firmly asserts that Bohr cannot have come into contact with James' ideas before 1932, long after the formulation of the complementarity principle.[335] Bohr himself contradicts this. When interviewed by Thomas Kuhn and others in 1962 Bohr says that he had been recommended to read William James by his childhood friend and cousin Edgar Rubin, who later became a psychologist, and this was before 1912.[336] The third and most likely alternative is that there was an indirect influence resulting from Bohr's close contact with Harald Høffding, whose philosophy and psychology has many similarities to that of James. In Høffding we find the same interest in the preservation of identity, criticism of von Hartmann's use of the concept of the unconscious, emphasis on the importance of being aware of the conditions under which experiments are conducted, especially in the field of psychology, because the experimental situation itself influences the person to be observed.[337] Høffding was in James' own opinion 'a first rate pluralist and pragmatist'.[338]

Høffding's pragmatic criterion of truth argues that the truth of a principle does not depend on its conformity to an absolute order of things but on its ability to arrange and unify our observations, i. e. to establish the greatest possible unity of our experiences. Høffding calls this concept of truth 'dynamic' and 'symbolic'. It is 'dynamic' because truth changes with our experiences, 'symbolic' because truth does not constitute an absolute, but a relative similarity or analogy between the idea and the object. We recognize this standpoint in Bohr's view of wave and particle as symbols and his as-

[334] Max Jammer, *The Conceptual Development of Quantum Mechanics* (New York, 1966), 349 ff; Folse, 181 ff; Klaus Meyer-Abich, Korrespondenz, Individualität und Komplementarität (Wiesbaden, 1965), 133 ff; Holton, 'The Roots of Complementarity', 133 ff.

[335] Folse, 49. See also Favrholdt, 64.

[336] Jan Faye, *Niels Bohr: His Heritage and Legacy* (Dordrecht, 1991); xvii; David Favrholdt very correctly points out that the psychologist Edgar Rubin is an interesting and, unfortunately, often overlooked person in relation to the historiography of Niels Bohr. It is not altogether impossible that Bohr's views on psychology were influenced by discussions with Rubin (although in a recent lecture at the Annual Meeting of the Swedish Association of the History of Psychology (June 18th-19th 2003) professor of psychology Arne Petersen, Copenhagen University, Denmark, stated that Rubin and Bohr 'hated each other' and disagreed on most points concerning psychology). Rubin became known for his study of the relation between ground and figure in visual perception, exemplified by his famous Rubin vase from 1921, and is associated with the school of Gestalt psychology (even if Rubin resented being linked to Gestalt). But here again the common denominator is Høffding who influenced Rubin's views on psychology.

[337] Høffding, *Psykologi i Omrids på Grundlag af Erfaringen* (Copenhagen 1882), 21; Høffding, 'Begrept Villie', *Psyke* 1 (1906). See also Faye 98.

[338] James to C.S. Schiller, 14 Sep. 1904, William James, *Selected Unpublished Correspondence 1885–1910*, ed. Frederick J. Down Scott (Columbus, Ohio, 1986), 349.

sertion that physics is not a description of the innermost essence of physical phenomena but a method of ordering and summarizing our experiences.[339] Something similar is found in James who considered theories as working instruments and not answers to questions about the nature of reality. Truth is something that in the long run is the most fertile basis for action. Truth is linked to usefulness, to the capacity to produce new knowledge and therefore to propel science forward. Høffding states exactly the same.[340]

The first time Bohr mentions the parallels between the situation in quantum mechanics with that in psychology is in his essay 'The Quantum of Action and the Description of Nature', published in 1929. This is the first essay to deal with the broader interpretation of quantum mechanics. Here Bohr's analysis of the measuring problems in microphysics leads him to the field of psychology, and to the issue of the relation between subject and object. Bohr emphasizes that the two sciences physics and psychology are confronted here with a similar epistemological situation.[341]

> The epistemological problem under discussion may be characterized briefly as follows: For describing our mental activity, we require, on one hand, an objectively given content to be placed in opposition to a perceiving subject, while, on the other hand, as is already implied in such an assertion, no sharp separation between object and subject can be maintained, since the perceiving subject also belongs to our mental content. From these circumstances follows not only the relative meaning of every concept, or rather of every word, the meaning depending upon our arbitrary choice of viewpoint, but also that we must, in general, be prepared to accept the fact that a complete elucidation of one and the same object may require diverse points of view which defy a unique description. Indeed, strictly speaking, the conscious analysis of any concept stands in a relation of exclusion to its immediate application.[342]

To clarify the gradual transition from subject to object, Bohr gives the example of the cane. If one tries to find one's bearings in a dark room with the aid of a cane, then one will quite soon come to consider the point of the cane as the part one feels with. One has, so to speak, 'extended' one's self to the point of the instrument. One no longer notices where one ends and where the cane begins; it has become an extended arm. But if we hold the cane loosely, then although we feel how it strikes various objects in the room, we

[339] Bohr, 'Introductory Survey', *Collected Works of Niels Bohr*, vol. 6, 296.

[340] William James, *Pragmatism* (New York, 1907), 53; Høffding, 'En filosofisk Bekendelse' (1904) in *Mindre Arbejder* III(Köpenhamn, 1913), 25; idem, *Moderne Filosofer* (Köpenhamn, 1904), 84; see Faye, 80. We find similar ideas also in Mach and Poincaré. The similarities between the philosophies of Høffding, James and Mach may explain why it has been difficult to decide whether the philosophy of the Copenhagen School should be termed pragmatic, instrumental positivist or phenomenological.

[341] Bohr, 'The Quantum of Action', *Collected Works of Niels Bohr*, vol. 6, 212.

[342] Ibid.

will be more likely to receive an impression of the cane than of the things it knocks against. If we hold the cane tightly, we feel *with* it, it becomes a part of the subject – but if we hold it gently, we feel the cane itself, it becomes something outside ourselves, an object. We can therefore relate to this cane in two ways, but never in both ways at the same time. Something similar applies to our concepts: when we use them to feel, think and understand with, they are a part of us: the subject. But when we examine the concepts, think about them and try to understand them, then they are objects. The problem of our words and concepts is by all means subtler than in the example of the cane, because when we reflect on the concepts they are object and subject at the same time. The same naturally applies when we want to study the psyche.

We know that Bohr had discussed this issue with Høffding. Høffding had devoted some attention to it when analysing the problems of self-observation in his book on psychology. It is for instance impossible to take action and at the same time carefully study the motives behind the action. Concentrating on the action excludes a simultaneous reflection on it. While acting the subject is at one with the action, when reflecting on the action it is made into an object that can be described. Høffding also underlines that the observing and the observed part of consciousness cannot be entirely kept apart, and that attention itself changes the psychological state that one wants to observe.[343] This reasoning is very close to that of William James' in his chapter 'Stream of Thought' in the book *The Principles of Psychology*. This is the chapter that Bohr mentions having read on the recommendation of Edgar Rubin and seems to have made a strong impression on him.[344]

In this chapter James describes consciousness as continuous. Not even sudden events are entirely divorced from what was before and what comes afterwards. This state of affairs he calls *the stream of consciousness*. 'Consciousness, then, does not appear to itself chopped up in bits, [...] it flows. [...] *let us call it the stream of thought, of consciousness, or of subjective life*.'[345] Although consciousness is seen as continuous, this 'stream of consciousness' does not flow uniformly, but with a particular rhythm that alternates between rest and motion. '*Let us call the resting-places the ›substantive parts‹ and the places of flight ›the transitive parts‹, of the stream of thought*.'[346] The purpose of these transitive parts of consciousness is to lead us from one substantive

[343] Høffding, *Psykologi i Omrids på Grundlag af Erfaringen* (Copenhagen 1882), 21.
[344] Holton, 138; Faye, xvi-xvii.
[345] William James, *The Principles of Psychology* (1890), (Cambridge, 1981), 233.
[346] Ibid., 236.

conclusion, where thought can find a contemplative state of rest, to the next. The actual transitions from motion to rest form an indivisible whole and cannot be subjected to detailed analysis. At the very instant we try to stop and contemplate the transitive part, it ceases to be in motion. If we wait until we have reached a 'resting point', the motion has passed. The attempts to analyse this relationship may be compared with the attempt to seize a spinning top in order to catch its motion or to turn up the gaslight quickly enough to see how the darkness looks.[347]

In Bohr's essay 'The Quantum of Action and the Description of Nature', there are passages reminiscent of William James' *Stream of Thought*.

> In particular, the apparent contrast between the continuous onward flow of associative thinking and the preservation of the unity of the personality exhibits a suggestive analogy with the relation between the wave description of the motions of material particles, governed by the superposition principle, and their indestructible individuality.[348]

When Bohr describes the impossibility of making a detailed analysis of the transition of an atom from one stationary state to another we recognize both Høffding's and James' basic thoughts on the relation between subject and object in the act of self-observation.

> Indeed, any attempt to trace the detailed course of a transition process would involve an uncontrollable exchange of energy between the atom and the measuring instruments, which would completely disturb the very energy balance we set out to investigate. [---] the notion of complementarity serves to symbolize the fundamental limitation, met with in atomic physics, of the objective existence of phenomena independent of the means of their observation.[349]

The term 'complementarity' seems to have come from James.[350] When James wishes to describe an experiment by Pierre Janet, the psychologist and neurologist at Salpêtrière who had specialized in personality disorders, he says:

> It must be admitted, therefore, that *in certain persons*, at least, *the total possible consciousness may be split into parts which coexist but mutually ignore each other*, and share the objects of knowledge between them. More remarkable still, they are *complementary*. Give an object to one of the consciousnesses, and by that fact you remove it from the other or others. Barring a certain common fund of information, like the command of language, etc., what the upper self knows the under self is ignorant of, and *vice versa*.[351]

[347] Ibid., 237.
[348] Niels Bohr, 'The Quantum of Action and the Description of Nature' (1929), *Collected Works of Niels Bohr*, vol. 6, 215–16.
[349] Niels Bohr, 'Light and Life' (1932), *Atomic Physics and Human Knowledge*, 6–7.
[350] Holton, 141–142; Jammer, 350.
[351] James, *The Principles of Psychology*, 204.

Bohr showing Pauli the 'tippetopp'
'The attempt at introspective analysis in these cases is in fact like seizing a spinning top to catch its motion, or trying to turn up the gas quickly enough to see how the darkness looks.' (William James, The Principles of Psychology)[353]

A few pages further on, he says: 'Few things are more curious than these relations of mutual exclusion…'[352] In a person with a split personality consciousness may be divided into different sub-personalities which exist side by side, but ignore each other. However they share the objects of knowledge together and the strange phenomenon arises that when the one sub-personality is aware of this object, it is excluded from the consciousness of the other sub-personality. Together, however, the sum of the complementary states of consciousness forms the normal personality.

Bohr might have picked up the term from James, or from Høffding who had applied the idea of a complementary relationship between a causal psycho-

[352]Ibid., 207.

[353]Courtesy *Niels Bohr Archive*, Copenhagen, Photo No. B067, Inauguration of the Institute of Physics, Tippetop; James, *The Principles of Psychology*, 237.

logical explanation of an act and an ethical description based on the concept of free will. Høffding even considered that the relation between mind and matter could be a complementary one.[354] It is hard to prove from where Bohr took the concept. He could even have picked it up from Henri Bergson, whose philosophy emphasizes the complementarity relationship between thought and intuition. But here again Høffding would have been the mediator, since we know that Høffding was teaching Bergson's hilosophy as part of his curriculum.[355]

We see how Bohr's whole epistemological position oscillates around the conditions of human knowledge. Among these conditions the relationship between subject and object, the issue of communication of experience and the limits of language are of fundamental importance. Bohr seemed eager to emphasize the analogies between the situation in quantum physics and other fields of knowledge. As examples he mentioned the conflict between a vitalist and a mechanistic approach to biology, the exclusive relationship between thought and feeling (or experience and analysis) in psychology and between free will and causality in ethics, and the visible contrast between different cultures. All these things can, according to Bohr, be illuminated from a complementarity perspective. To him this was not a question of superficial similarities but an analogy based on the common epistemological situation in all human knowledge.[356]

In biology the analysis of the chemical and atomic components of life stands in a complementary relationship to the indivisible phenomenon of 'life', as every attempt to analyse in detail the components of the organism tends to extinguish the very phenomenon that one wishes to study.[357] In the field of ethnology every contact with an exotic culture involves an intervention in it that cannot be controlled, while at the same time the observer may have his prejudices shaken and his worldview altered. Ideally this may lead one to see oneself and one's own culture in a larger perspective.[358] This led Bohr to believe that the complementarity principle could be applied as a general epistemological principle to help us find our way when in various areas we are caught between apparently contradictory viewpoints. His belief in the importance of this principle was so great that he hoped that it would be taught

[354] Faye, 75.

[355] Harald Høffding, *Henri Bergson's filosofi: karakteristik og kritik* (Copenhagen, 1914), Faye, 25.

[356] Niels Bohr, 'Atomphysik und Philosophie – Kausalität und Komplementarität' (1958), *Atomphysik und menschliche Erkenntnis* (Braunschweig, 1985), 110.

[357] Idem, 'Biology and Atomic Physics', *Atomic Physics and Human Knowledge* (New York, 1958), 20–22.

[358] Idem, 'Natural Philosophy and Human Cultures', ibid., 29–30.

Niels Bohr's Coat of Arms
In 1947 Niels Bohr was awarded the order of the elephant and for the occasion he devised a coat of arms that would be hung in Fredriksborg Castle Church. He chose the Chinese symbol 'tai-chi', which symbolizes the opposing forces of the universe, Yin and Yang, and their complementary interaction. The Latin motto contraria sunt complementa expresses the same thing.[360]

in elementary school.[359] It is obvious that Høffding inspired this attitude of Bohr's. In his speech at the Tenth International Psychology Congress in Copenhagen in 1932 Bohr characterizes Høffding's approach to science by saying that he took the new discoveries in physics and tried to find analogies to them in psychology 'in order to make the new progress fruitful in psychology'. Bohr admired Høffding's efforts to find overlapping areas between different sciences, and especially his cautious hope that complementarity could be a 'field where psychologists and physicists may be of great mutual help'.[361]

[359] Interview with Bohr AHQP, see Beller, 279.
[360] Niels Bohr's Coat of Arms, Photo No. P008, Courtesy *Niels Bohr Archive*, Copenhagen.
[361] Faye, 68–69; Welcome speech held at the Tenth International Psychology Congress in Copenhagen in 1932, Niels Bohr Archive, MSS:13.

Niels Bohr and C.G. Jung

We have taken a brief look at Niels Bohr's philosophical assumptions. In our context these are particularly important, because Bohr was a major source of inspiration to Pauli. Working with Bohr, Pauli learned a philosophical approach that prepared him for his encounter with the psychology of Jung. Pauli himself claimed that he learned antinomic thinking from Bohr, in other words a thinking based on paradox and the mutual interplay of opposites. Here we approach the interesting question of the relationship between different intellectual temperaments for the development of science and ideas. It seems that working and debating with people with a different temperament from his own particularly inspired Pauli. But it was an ambivalent affair: he was repelled and irritated by the other party's lack of precision and coherence, but attracted by the fertilization and stimulation provided by their creative ideas. This was the case with Pauli's attitude towards with Heisenberg, Bohr and Jung.

We can here speak of the difference between a system thinker and a problem thinker, to use the concepts of Nicolai Hartmann, or between the thinking and the intuitive type, to use Jung's terminology. The system thinker or thinking type makes the effort to construct a complete intellectual edifice in which the various parts form a logical whole. The problem thinker or intuitive type, on the other hand, who admittedly may also be looking for an all-embracing viewpoint, works with a number of different subordinate and sometimes contradictory concepts. The problem thinker/intuitive prefers an open search to the selection and elimination of possibilities. The system thinker wishes to reach clear and definite solutions and definitions, whereas the problem thinker wishes to experiment with different ideas and different ways of handling the problem and is more interested in the search than in the answer.[362] It seems that the confrontation between these two types is especially creative.

It is interesting to note that the description of Bohr's personality and that of Jung show many similarities. They have both been labelled mystics, positivists, '›gurus‹ inspiring by personal contact', 'intuitives', 'building a huge mythology', 'deep and subtle' or alternatively 'obscure'. The work of both

[362] J.J. Clarke, *In Search of Jung: Historical and Philosophical Enquiries* (London, 1992), 18–19.

men bears a strong personal stamp and is said to have sprung from their inner world.[363] What is interesting here is neither the derogatory nor the hagiographic nature of the descriptions of Bohr and Jung, but the similarities in the descriptions. I would argue that there exist more similarities between Bohr and Jung's outlooks than these shared labels. A comparison of the views of Bohr and Jung will make it clearer why Pauli felt that with Jung he had the chance to go more deeply into questions and perspectives that had been introduced to him while with Niels Bohr.

If we can say that physics with Bohr in the frontline moved from a purely scientific and mathematical analysis towards an increasing interest in theory of knowledge and in psychology, then the depth psychologist C.G. Jung may be said to have moved in exactly the opposite direction. His starting point was primarily a psychiatric analysis that included word association tests and reaction times. From this he continued to the study of the problems and constitution of the individual by the analysis of neuroses and psychoses. He immersed himself increasingly in the study of symbols as they are expressed in the products of the imagination and in dreams. For comparative purposes he began also to study the collective symbols of humanity as they occur in mythology, religion and folklore. There he found striking parallels with the individual material. From studies of history of religion he went on to the study of early philosophical and scientific conceptions and models in order to trace what he by now was calling archetypal patterns in the production of ideas.

To Jung the question of the relationship between subject and object had always been highly significant.[364] He objected in particular to the fact that inner experiences were not credited with any importance by comparison with the apparently unproblematic sensory impressions. Therefore, although he did not feel at home in the field, he became interested in what was happening in modern physics, when this subject matter came into focus. He naturally took note of the fact that physicists themselves were making direct comparisons between the situation in modern physics and the situation in psychology. Jung welcomed an overthrow of the old scientific ideals, ideals that treated his research and work as, at best, philosophical speculation.

[363]For the description of Bohr, see Beller, 244 ff., for the description of Jung see Richard Noll, *The Jung Cult* (Princeton, 1994).

[364]Jung had been reading philosophers like Goethe, Kant, Schopenhauer and Nietzsche who all put emphasis on questions concerning the relationship between spirit and body, subject and object, determinism and free will, causality and acausality, rational and irrational.

C.G Jung and William James

The most frequently encountered description of Jung's psychology is that it primarily evolved from the psychoanalysis of Sigmund Freud. This is a misleading portrayal, which underestimates the significance of other influences on Jung's conceptual development. It is true that Freud had a great influence on Jung in many ways, but Jung did not come to Freud as an empty vessel, and he in turn also exerted a considerable influence on Freud. It is therefore at least equally important to look at other influences on Jung's thinking.[365] In our context William James is particularly interesting. The influence of James on Jung's thinking is in fact quite extensive. Apart from influencing Jung's view of science and epistemology – which will be dealt with here – he also influenced two of his major theories: the theory of psychological types and the theory of the collective unconscious.

According to Jung's own account he had read Freud's *Traumdeutung* as early as 1900, but did not at the time feel at home with it. He returned to it in 1903, this time captivated by its contents.[366] There is much evidence that Jung absorbed the writings of James before he began to take an interest in the theories of Freud. In his doctoral dissertation *On the Psychology and Pathology of So-called Occult Phenomena*, which he presented to the Faculty of Medicine at Zürich University in 1902, he quoted two cases of split personality from James' book *The Principles of Psychology*. Jung himself did not hesitate to state what James had meant to him:

> In my survey, far too condensed, I fear, I have left unmentioned many illustrious names. Yet there is one which I should not like to omit. It is that of William James, whose psychological vision and pragmatic philosophy have on more than one occasion been my guides. It was his far-ranging mind which made me realize that the horizons of human psychology widen into the immeasurable.[367]

[365] Richard Noll has pointed to Ernst Haeckel's influence on Jung, Gilles Quispel to the relevance of the gnostics, and Eugene Taylor to the importance of William James. Richard Noll, *The Jung Cult* (Princeton, 1994), 51 f; Gilles Quispel, 'C.G. Jung and Gnosis: The Septem Sermones ad Mortuos and Basilides' (1968), *The Gnostic Jung*, ed. Robert A. Segal (Princeton, 1992), 219–238; Eugene Taylor, 'William James and C.G. Jung', *Spring* (1980), 157–167.

[366] C.G. Jung, *Memories, Dreams, Reflections*, ed. Aniela Jaffé (Glasgow, 1977), 169.

[367] Idem, 'Psychological Factors', *C.W.*8, §262. Cf idem, 'Concerning the Archetypes with Special Reference to the Anima Concept' (1954), *C.W.*9*I*, §113.

James may also be said to have been Jung's guiding light in 1912, when he first published his dissenting view of the nature of psychic energy, which completed the break between himself and Freud. In the preface to the first edition of *The Theory of Psychoanalysis*, Jung invokes James and his view of science in defence of his right to publish an opinion that is at variance with Freud's.

> It has been wrongly suggested that my attitude signifies a 'split' in the psychoanalytic movement. Such schisms can only exist in matters of faith. But psychoanalysis is concerned with knowledge and its ever-changing formulations. I have taken as my guiding principle William James' pragmatic rule: You must bring out of each word its practical cash-value, set it at work within the stream of your experience. It appears less as a solution, then, than as a program for more work, and more particularly as an indication of the ways in which existing realities may be changed. *Theories thus become instruments, not answers to enigmas, in which we can rest*. We don't lie back upon them, we move forward, and, on occasion, make nature over again by their aid.[368]

Jung took this quotation from the 1907 edition of James' *pragmatism*. Although Jung's clinical experience differed from Freud's he still wanted to consider himself a defender of psychoanalysis in the broader sense. James helped to shape Jung's basic view of science as an instrument rather than as a goal in itself. He saw James as a pioneer, in that he had realized that science has to be pursued pluralistically if it is not to stagnate – with the aid of a number of different and sometimes even contradictory principles which complement each other. What Jung most admired in James' pragmatic position was his critical attitude to the type of positivism and reductionism that dismisses values and inner experiences. Jung loved to quote James' phrase 'nothing but', as a designation of the reductionist attitude which attempts to explain away something unknown by reducing it to something known and therefore robbing it of its inherent value.[369] Jung turned especially against the tendency to reduce the religious and philosophical needs of mankind to more elementary components, such as an infantile need for protection.[370] Jung's dislike of reductionism is of an early date. When Jung was only 23, in 1898, he criticized both the subjectivist and the materialist position for their one-sidedness. The materialist position tries to draw conclusions regarding the internal on the basis of the external, and the subjectivist does the op-

[368] Idem, 'The Theory of Psychoanalysis: Foreword to the First Edition' (1912), *C.W.*4, 86.

[369] 'Ideals appear as inert byproducts of a physiology; what is higher is explained by what is lower and treated for ever as a case of ›nothing but‹ – nothing but something else of a quite inferior sort.' James, *Pragmatism*, 16. Cf, for example, C.G. Jung, *C.W.*7, §67, 400, 474; *C.W.*6, §315, 593, 600, 867; *C.W.*17, §157 etc.*C.W.*8, §423.

[370] Idem, 'On Psychological Understanding', *C.W.*8, §423.

posite. A productive approach must instead have an empirical basis; it must be based on true experience. True experience includes all our experiences, both internal and external, and the former cannot be credited with a greater degree of reality than the latter.[371] In Jung's opinion man's inner world has the same degree of autonomy as external reality. An idea or a conception is seldom the result of a conscious thought process but is more often something which simply 'comes to us', ready formulated and with an intrinsic power of persuasion which gives it the character of an 'absolute truth'. We are not, according to Jung, 'masters in our own house', in other words we do not control our inner world. To believe that we possess our psyche is like a fish believing that it contains the sea.[372] The psyche is made up of a world of autonomous processes, in which the ego is one factor. Dreams, hallucinations, fanatical convictions, compulsive ideas, phobias and so on are manifest examples of the autonomous processes of the psyche.

Although Jung considered that both James and Freud had too limited a view of the extent of the unconscious, he nevertheless considered William James to be the first to appreciate the significance of Frederic W.H. Myers' concept of *subliminal consciousness*. With regard to the discovery of this concept, James says:

> I cannot but think that the most important step forward that has occurred in psychology since I have been a student of that science is the discovery, first made in 1886, that, [–––] there is not only the consciousness of the ordinary field, with its usual centre and margin, but an addition thereto in the shape of a set of memories, thoughts, and feelings which are extra-marginal and outside of the primary consciousness altogether, but yet must be classed as conscious facts of some sort, able to reveal their presence by unmistakable signs. I call this the most important step forward because, unlike the other advances which psychology has made, this discovery has revealed to us an entirely unsuspected peculiarity in the constitution of human nature. No other step forward which psychology has made can proffer any such claim as this.[373]

When James first quoted Myers in 1888 he referred to Myers' impression that the subliminal consciousness extends from the animal archaic to the transcendentally divine. This notion comes close to Jung's view of the so called collective unconscious. Jung also referred to James' view of our mental 'fields', each with its centre of interest and with an indeterminable margin or fringe that fades into a subconscious region. In this region there are processes of incubation going on, 'a maturing of motives deposited by the

[371] C.G. Jung, 'Thoughts on the Nature and Value of Speculative Inquiry' (Summer Semester 1898), *The Zofingia Lectures, C.W. A*, §175.
[372] Idem, Commentary on 'The Secret of the Golden Flower' (1929), *C.W.*13, §75.
[373] James, *The Varieties*, 234.

experiences of life' ready to 'burst into flower'. These 'fields of consciousness' are compared to a magnetic field inside which our centre of energy turns like a compass needle. Beyond the margin floats our whole past store of memories, knowledge, impulses and other potential powers ready to burst in. They guide our behaviour as well as the next movement of our attention.[374] This field concept of James' is strikingly similar to how Jung pictures the collective unconscious as a field with specific energetic dominants called complexes or archetypes.[375] In the definition of the collective unconscious which Jung gave in 1931 we recognize James' wording: 'The collective unconscious [–––], seems to be [–––] like an unceasing stream or perhaps ocean of images and figures which drift into consciousness in our dreams or in abnormal states of mind.'[376]

However it should be recalled that James criticized the concept of 'the unconscious'. He criticized, among others, the philosophy of von Hartmann and his use of the term. James preferred to speak of different 'states of consciousness', and defined the subliminal as unimaginably quick acts of consciousness, so quick that they are instantly forgotten.[377] His main criticism of the concept was however from the standpoint of a theoretician. 'It is the sovereign means for believing what one likes in psychology, and of turning what might become a science into a tumbling-ground for whimsies.'[378] Interestingly enough Pauli's criticism of Jung's concept of the psyche is of the same kind as James' arguments against the concept of the unconscious. It seems that he felt more familiar with those aspects of Jung's view of the psyche that came close to James' definition of the subliminal (which emphasizes its nature of borderline phenomena) than with those aspects that reminded of von Hartmann's romantic notion of the unconscious as a kind of spiritual force. At the same time he found it unacceptable to define the unconscious as a kind of consciousness. (We will return to Pauli's criticism below.) Be that as it may, when Pauli read William James' *The Varieties of Religious Experience* (which he probably did in the 1950s) he is very much impressed by the above-mentioned passage where the field of consciousness is compared to a magnetic field and our centre of energy to a compass needle. The comparison of the unconscious to a physical field appeared a very apt one to Pauli and was something that had occupied his thoughts for quite a while.[379]

[374] C.G. Jung, 'On the Nature of the Psyche', *C.W.*8, §382; James, *The Varieties*, 232–233.
[375] Jung, 'On Psychic Energy', *C.W.*8, §18 f.; idem, 'On the Nature of the Psyche', ibid., §381–387.
[376] Idem, 'Basic Postulates of Analytical Psychology', ibid., §674.
[377] James, The Principles of Psychology, 168.
[378] Ibid., 166.
[379] Pauli to Meier, 6 February 1954 [1713], *PLC IV/2*.

It is most probable that William James influenced Jung with his view of the particular epistemological situation of the psychologist, where consciousness is both the subject and the object of examination. Jung always stressed that the particular predicament of psychology is that it has no Archimedean point outside itself. Psychology has no medium in which to reflect itself: it can only present itself in psychically conditioned terms, i. e. describe itself in terms of itself.[380] Jung had of course been confronted with the problems of the subject-object relationship in his reading of Kant and Schopenhauer much earlier.[381] In Jung's view, knowledge is always an *interaction* between subject and object, a viewpoint that he had already expressed in *Psychological Types* in 1921. In his opinion, the psychologist's empirical foundation consists of *psychic facts*. A psychic fact is the result of an interplay or interaction (action or reaction) between subject and object.[382] We compare William James' description of what he calls a *full fact*:

> A conscious field *plus* its object as felt or thought of *plus* an attitude towards the object *plus* the sense of a self to whom the attitude belongs – such a concrete bit of personal experience may be a small bit, but it is a solid bit as long as it lasts; not hollow, not a mere abstract element of experience, such as the 'object' is when taken all alone. It is a *full* fact, even though it be an insignificant fact; it is of the *kind* to which all realities whatsoever must belong…[383]

All our knowledge consists of psychological facts; it is only their places of origin that differ. A sensory impression has its origin in external reality, whereas a dream has its origin in internal reality. The medium that receives information and processes it is the psyche. Both the sensory impression and the dream have to be regarded as psychic realities, which have an influence on us. This position Jung calls the *reality of the psyche*. This principle assumes that reality is always perceived through the psyche and that this is the only reality we know of. However this does not mean that reality is *in itself* psychic or intra-mental.[384] Jung was convinced that there is an objective reality that causes the sensory impression and the dream, but how this reality is constituted is something on which we can only speculate. Jung shared the view of Immanuel Kant that we cannot know anything about the *thing in itself*, in other words, about the innermost nature of reality. The innermost nature of reality is *metapsychic* or *transcendental*, which means that it is beyond all

[380] Jung, 'Psychological Types', *C.W.*6, §672–674; idem, 'On the Nature of the Psyche', *C.W.*8, §421.
[381] *C.G. Jung Speaking*, ed. William McGuire (London, 1977), 203–204, 249; C.G. Jung, *Analytical Psychology: Notes of the Seminar Given in 1925*, 4.
[382] Jung, 'Psychological Types', *C.W.*6, §621–622.
[383] James, *The Varieties*, 476.
[384] This is incorrectly asserted by Marylin Nagy in *Philosophical Issues in the Psychology of C.G. Jung* (New York, 1991), 35, 52, 55, 145.

our known categories.[385] We cannot know anything definite about the true nature of either matter or the spirit, we can only answer with certainty that we experience effects of a reality, independent of ourselves, which we designate material or spiritual. Reality is not therefore primarily some external object, but consists of everything that acts on us. Reality is what *works*, i. e. has an *effect* upon the human psyche.[386] This definition of reality is most certainly inspired by William James' pragmatic criterion of truth.[387] Human products can furthermore be looked upon as 'psychic facts': religious beliefs, art, philosophical and scientific theories – all these can in a certain sense be seen as 'psychic phenomena', since they *also* give us information about how our mind works. As psychic phenomena they represent real facts about the psyche and in that sense they contain *psychological truths*.

> When an idea is so old, and is so generally believed, it is probably true in some way, and, indeed, as is mostly the case, *is not literally true, but is true psychologically*. In this distinction lies the reason why the old fogies of science have from time to time thrown away an inherited piece of ancient truth; because it was not literal but psychologic truth.[388]

A statement is 'psychologically true' in the sense that even if it is clearly not true in an objective sense it tells us about the way the mind functions. This assumption was not primarily a philosophical viewpoint to Jung but the basis of his way of working with his patients; it was for him the direct route to an insight into their minds.[389] In his effort to understand and help his patients Jung's first, and in fact only, concern was to take people's statements and experiences seriously, even if they were contrary to so-called 'common sense'. He had this in mind when he elaborated his constructive, or synthetic, method, a method opposed to reductionism and to classic scientific causality.

[385] Jung, 'On the Nature of the Psyche', *C.W.*8, §362, 420.

[386] Idem, 'Psychological Types', *C.W.*6, §60; 'Psychology and Religion', C.W. 11, §757.

[387] Idem, 'Answer to Job' (1952), *C.W.*11, §757.

[388] Idem, *Psychology of the Unconscious: A Study of the Transformations and Symbolisms of the Libido* (1916), (Princeton, 1991), §6. (Cf idem, *C.W.*5, §4.)

[389] This viewpoint is criticized by Erich Fromm in *Psychoanalysis and Religion* (New Haven, 1950), 15–16. Fromm considers that the concept of truth may only be applied to an absolutely ascertainable truth, which makes it possible to distinguish between illusion and reality. Religious truth corresponds to such an 'absolute truth', in Fromm's view. What is essential to Jung, on the other hand, is that a conception exists, not that it is 'true' in any absolute sense. If it exists and is acting in the human mind, then it is psychologically real and thus psychologically 'true'. Jung equates psychological truth and psychological reality, in other words the viewpoint which he calls 'the reality of the soul'. This cornerstone of Jung's attitude is fundamental to his ambition to understand his patients and take their experiences seriously. He had no time for the authoritarian doctor-patient relationship which is based on the doctor's creating a distance between himself and the patient by means of diagnostic labels. Often, therefore, he also puts the category 'normal people' in inverted commas or writes 'so-called normal' people. Cf Jung, 'Psychology and Religion', *C.W.*11, §11.

> . . . the constructive method, true to its nature, must follow the clues laid down by the delusional system itself. The thoughts of the patient must be taken seriously and followed out to their logical conclusion; in that way the investigator himself takes over the standpoint of the psychosis. This may expose him to the suspicion of being deranged himself. . .[390]

With 'the reality of the psyche' as starting point Jung believed that it was possible to proceed beyond the old conflict between idealism and materialism. Existence does not have to be reduced to the one or the other if it is realized that reality is, to us, ultimately psychic. The psyche is the medium, which combines physiological and spiritual information in a psychic fact. Spirit and matter are only names for the perceived source or place of origin of the mental content.[391] We know as little about the innermost nature of matter as we do about that of the spirit. The mistake that many philosophers have made, says Jung, is that they have identified the human psyche with the spirit, thus made spirit the subject, and matter the object. Such a one-sided and erroneous division must, like all distortions, eventually be reversed. Jung therefore saw it as symptomatic that we live in a time when the metaphysics of the spirit is being replaced by the metaphysics of matter. It is a remarkable state of affairs when psychology is trying to reduce the soul to biochemical processes and movements of electrons, while physics is trying to explain the lack of regularity in the interior of the atom as evidence of spiritual life.[392]

What is special about the position of modern [i. e. Jung's] psychology, according to Jung, is that it can no longer allow itself to reduce the spiritual to the physical or vice versa. It has instead to find a new viewpoint, a viewpoint characterized by both-and.[393] A third viewpoint is needed which can unite the physical and the spiritual explanatory perspective. This third viewpoint is the *reality of the psyche*. Like Kant and James, Jung argues that we cannot know what is 'true' or 'real' beyond our conceptions. We can never know anything about the *thing in itself*. The only reality about which we can speak, therefore, is psychic reality and psychological truths. We cannot reach beyond the psyche.

[390] Idem, 'On Psychological Understanding',(1914), *C.W.*8, §421–423.
[391] Idem, 'Basic Postulates', *C.W.*8, §680–81.
[392] Ibid., §650.
[393] Idem, 'Basic Postulates', *C.W.*8, §679.

The Epistemological Theories of Jung and Bohr

Niels Bohr's viewpoint will be compared here with Jung's view of the relationship between language, reality and science. Bohr had thus stated that in modern physics it is no longer possible to speak of the material object in itself, instead the building blocks of physics are the so called physical phenomena. A physical phenomenon is defined as the interaction between measuring instrument and measured object. In the course of time he clarified the new situation in physics by underlining that this interaction should not be regarded as a 'disturbance' of the observed object because this might lead to the belief that we can distinguish between the 'disturbance' and the object, which is exactly what we cannot do. The quantum phenomena has a character of *individuality* and *wholeness*, because every effort at division or demarcation between what is observed and what is observing is arbitrary. Bohr redefined the term 'phenomenological object' to mean the result of this interaction, which means that every description of the phenomenological object must include a complete description of both the experimental device and the observed results.[394]

Behind these phenomenological objects Bohr nevertheless postulated an objective reality, whose effects we can measure in the form of particles or waves. Bohr therefore assumed the existence of an atomic system, concerning the reality of which the physical phenomena give complementary information. For that reason Henry Folse and others claim that Bohr has to be considered a *realist*. Jan Faye compares Bohr's standpoint on reality with that of Høffding, who called himself a constructive realist, a position that is based on his dynamic concept of truth. There exists an objective, mind-independent reality but we can never wholly grasp it with our thoughts. We can only construct a plausible concept of reality based on certain basic postulates, which we might later have to revise. We are constructing a picture of reality that is based on our experience (i. e. interactions) with objective reality, but this picture can never be compared with reality *per se*. What we *can* do is construct better and better approximations, better ways of organizing our experience.[395]

[394] Folse, 158–59.

[395] Høffding, *Den menneskelige Tanke*, p. 106. Faye prefers to call this attitude objective anti-realism. Faye, 214 ff.

Bohr can thus be called a realist because of his assumption that the complementary information of physical phenomena gives as complete information concerning reality as is possible.[396] This also implies that objectivity cannot be based on an exact description of the characteristics of reality. It is instead the *characteristics of the description* that guarantee objectivity, in other words a well-defined conceptual apparatus. We have already noted that 'unambiguous communication' and clear conceptual formation were of great importance to Bohr. What he attached most importance to was not the nature of reality or what we can find out about it – but rather what we can *say* about it. As we have seen, Bohr redefined the concept of objectivity, using it to signify not 'description of an a priori reality' but 'the possibility of an unambiguous communication of experience'. Man is according to Bohr completely dependent on language, on his ability to communicate his experiences.

> What is it that we human beings ultimately depend on? We depend on our words. We are suspended in language. Our task is to communicate experience and ideas to others. We must strive continually to extend the scope of our description, but in such a way that our messages do not thereby lose their objective or unambiguous character.[397]

At the same time we must no less be aware of the limited area of application of our concepts and of the 'irrationality, which every analysis of a question, if driven far enough, reveals in existence, an irrationality which means that even the strictest and clearest presentation of a subject is ultimately no more than a painting in words.'[398] We cannot speak of reality other than in similes and images, and we must always be aware that our images and concepts do not completely correspond to reality. However the more light we can throw on the actual state of affairs from different perspectives – even if the perspectives appear contradictory – the more our knowledge of reality increases. We approach an understanding of it – but we can know nothing of its innermost essence. The origin of the particular problems of human language is to be found in man's position in the universe, namely his ability to make himself an object of observation, to be both observer and actor in the drama of life.

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[396] Folse, 164–65. This opinion may be compared with what is often designated 'representationalist realism'.

[397] Bohr quoted by Aage Petersen in 'The Philosophy of Niels Bohr', *Niels Bohr: A Centenary Volume*, eds. P. French and P.J Kennedy (London, 1985), 301.

[398] Bohr, 'Introductory Survey', *Collected Works of Niels Bohr*, vol. 6, 288. The English translation is 'we shall always have last recourse to a word picture', whereas the Swedish says, '*vi [. . .] alltid är hänvisade till att uttrycka oss genom att måla med ord. . .*' [we [. . .] are always thrown back on expressing ourselves by painting with words. . .] *Atomteori och naturbeskrivning* (Stockholm, 1967), 22. Cf Klein, 'Niels Bohr som tänkare', 413. See the discussion of the use of the concept 'irrational' below.

Jung states that only a small part of psychology can be observed as quantitatively measurable facts, the greater part is far too complex to be confined within the limits of such a method. The psychologist is instead dependent on a precise description of psychic phenomena, and consequently of the *precision and definition of his concepts*. In psychology, in particular, one has to be extra careful with concepts and expressions, since in this field more than in any other the same concepts can be used with quite different meanings. Psychological concepts are by their nature often imprecise and ambiguous and the psychologist must therefore take the trouble to define his concepts and make clear in what sense he is using them.[399] At the same time as one cannot do without exact definitions, one must also understand that the concepts do not 'explain' psychic facts. Reality is much too complex to be captured in concepts. One may believe of the concepts one uses that one has a grip on the phenomenon by giving it a well-known and secure name such as 'instinct' or 'chance'. In 1946 Jung expresses this point of view as follows:

> The moment one forms an idea of a thing and successfully catches one of its aspects, one invariably succumbs to the illusion of having caught the whole. One never considers that a total apprehension is right out of the question. Not even an idea posited as total is total, for it is still an entity on its own with unpredictable qualities. This self-deception certainly promotes peace of mind: the unknown is named, the far has been brought near, so that one can lay one's finger on it. One has taken possession of it, and it has become an inalienable piece of property, like a slain creature of the wild that can no longer run away. It is a magical procedure such as the primitive practises upon objects and the psychologist upon the psyche.[400]

Concepts and hypotheses which are used in a discipline are tools whose primary value lies in their heuristic qualities.[401] For that reason Jung was more concerned to give a composite description of reality than to codify psychic phenomena in abstract terms.[402] His terminology has for this reason frequently been criticized as blurred and contradictory. But Jung argues explicitly against a formalistic terminology: it leads people to learn the concepts by heart and then reduce experience to the preconceived concepts. Experience, the psychic facts, is overlooked while a sort of conceptual shadow-boxing takes place. The concepts are tools, which can never cover the complexity of experience. Presenting abstract concepts that do not correspond to everyday reality is pointless to a psychologist, whose most important tool is the abil-

[399] Jung, 'Psychological Types', *C.W.*6, §672–674.
[400] Idem, 'On the Nature of the Psyche', *C.W.*8, §356.
[401] Idem, 'The Relations Between the Ego and the Unconscious', *C.W.*7, §216.
[402] Ibid., §340.

ity to communicate with his patient.[403] If the psychologist wishes to give as complete a description of the psychic phenomena as possible, his language must from a logical point of view be ambiguous.

> The language I speak must be ambiguous, must have two meanings, in order to do justice to the dual aspect of our psychic nature. I strive quite consciously and deliberately for ambiguity of expression, because it is superior to unequivocalness and reflects the nature of life. [–––] I purposely allow all the overtones and undertones to be heard, partly because they are there anyway, and partly because they give a fuller picture of reality.[404]

Trying to describe complex reality is the task of empirical science. But the act of describing is in itself a rationalizing activity, admittedly necessary, but a falsifying one. No description can be total except one of a previously postulated concept, the description of which becomes a tautology. By excluding the accidental from empirical science one forms a rational picture of the object, which does not correspond to the fundamentally irrational nature of reality.[405] Science is the art of creating for ourselves a suitable illusion or a beautiful picture that we paint to please our senses. Real things are effects of something unknown and 'reality' is always something 'observed'.[406] Both Jung and Bohr thus emphasised the ambiguity of language and the difficulty of capturing reality with words, although with Bohr a greater stress was laid on the need for unambiguous communication.

Jung wished to regard himself as an *empiricist* in the sense that he studied natural phenomena – the inner world of the human psyche. Jung called his working method *phenomenological*, as his starting point was observing psychic phenomena without reducing them to something non-psychic. Jung agreed here with what William James had said on the study of religious phenomena and Émile Durkheim on the study of social phenomena – that these must be studied on their own terms. Jung regarded the human psyche as pure nature and human experience as psychic facts. But a fact is not in itself a simple thing and cannot be seen as something independent of the observer. A fact may contain experiences, which derive from both a physiological source and an immaterial or spiritual source. We can no more deny the autonomy of the psyche when we experience a disturbing dream or a paralysing phobia than we can deny the autonomy of the external world when we burn ourselves with fire. The fact that the alchemists believed that all metals have the potential

[403] Idem, 'The Structure of the Psyche', *C.W.*8, §286.
[404] Jung to Werblowsky, 17 Jun. 1952, *C.G. Jung Letters*, vol. 2 (Ewing, 1976), 70.
[405] Jung, 'Psychological Types', *C.W.*6, §775.
[406] Jung to Allen Gilbert, 02/01/1929, C.G. Jung Letters, vol. 1 (Ewing, 1973), 57. Idem, 'Analytical Psychology and ›Weltanschauung‹' (1927), *C.W.*8, §737.

to become gold is a fact – not a concrete fact, but a psychological fact and a conceptual phenomenon. The phenomenological method can be used to collect and describe these conceptions.

But Jung's epistemology does not stop at this 'phenomenological' attitude. He was convinced that there is an objective reality with which we interact and which we are always approaching, particularly by increasingly withdrawing our projections from it.[407] A phenomenon is *psychic* so long as it is verifiable as a *conception*, but it must never be forgotten that the objects of our experience lie outside our psyche and constitute *existences*.[408]

Toni Wolff, colleague and close friend of Jung with an interest in philosophical issues, argues that analytical psychology (also for a period of time called complex psychology) has to be considered a form of *realism*.[409]

> … complex psychology is an empirical science, to which the philosophical classification of realism would seem applicable. [–––] Realism has nothing at all to do with materialistic or biologistic ways of seeing things. The realistic viewpoint means seeing things as they naturally are. Human nature, in its broadest sense, is psychic, and includes as a matter of course all that belongs to the concept of the human state, in other words everything instinctive as well as all the highest spiritual and ethical achievements of consciousness, and also the objective psychic, which engages with the subjectivity of the individual as an autonomous factor and must by some conceptual process be integrated by it.[410]

Jung could be called a realist in the sense that he regarded the psyche as a piece of nature which can be observed on the same basis as a piece of physical nature, even if it must be borne in mind that the problem of demarcation between subject and object is particularly accentuated in psychology. To underline this conception of the psyche he also called the collective unconscious the *objective psyche*. It represents an autonomous factor that intervenes in the life of the subject in a form which cannot be ignored. It is also objective in the sense that it is *intersubjective*, in other words it is shared by all humans. Its forms of expression seem moreover to rest on the existence of structuring factors, which are in themselves non-visual and universal (archetypes).

Naturally Jung did not belong to the naive realists, he did not believe that we attain knowledge without taking the act of observation or the subjective

[407] C.G. Jung, 'Religion and Psychology: A Reply to Martin Buber' (1952), *C.W.*18, §1511.

[408] Jung to Pauli, 4 May 1953 [61J], *PJL*, 113.

[409] Toni Wolff, former patient of Jung, had according to C.A. Meier studied philosophy under Heinrich Rickert and was responsible for the most important parts in Jung's book on Psychological Types. Trained in philosophical thinking she helped him clarify many of his concepts. *Interview with C.A Meier*, April 6, 1993 (Preserved on Tape by the Author); see also Ronald Hayman, *A Life of Jung* (Bloomsbury, 1999), 218–19.

[410] Toni Wolff, 'Einführung in die Grundlagen der Komplexen Psychologie', *Die kulturelle Bedeutung der komplexen Psychologie*, ed. Psychologischer Club Zürich (Berlin, 1935), 42.

factor into account. A new psychic fact is created as a result of an action or reaction of the subject with the effect produced by an autonomous object. Thus Jung writes in his work *Psychological Types* from 1921 and Pauli underlined this sentence in his own copy of the book.[411] It is likely that in this choice of words he recognized the discussions he had had with Heisenberg and Bohr on the interaction of measuring instrument and object in quantum physics. Jung, in turn, particularly emphasises the importance of the interaction in connection with the therapeutic process. Psychotherapy is a dialectic process, a dialogue between two persons, where one psychic system starts to interact with another. The physician is then no longer only an observer but a participating companion in the process.[412] Both physician and patient influence each other and both are changed irrevocably.[413]

[411] The book is in 'La Salle Pauli' at CERN, Bellettrarisches No. 91; cf. *C.W.*6, §622.
[412] C.G. Jung, 'The Principles of Practical Psychology' (1935), *C.W.*16, §1, 8.
[413] Idem, 'Problems of Modern Psychotherapy', *C.W.*16, §163.

Bohr, Pauli and the Unconscious

'Why does Bohr have such a strong aversion to the concept of the ›unconscious‹'?[414] Pauli asks in a letter to Markus Fierz in 1953. Pauli had already noted in 1948 that Bohr never uses the word 'the unconscious' in his analogies of quantum physics and psychology, but only talks of consciousness. Therefore he must mean something completely different from Pauli when he speaks about the *unity of personality*. Pauli goes so far as to say that Bohr's analogies are arbitrary constructions.[415] We have so far concentrated on the similarities between Bohr's and Jung's approaches to show that Pauli's philosophical interest in Jung's psychology is not as far-fetched as it might seem at first glance. It must in fact be seen in the particular atmosphere that surrounded Pauli during his time with Niels Bohr. But now we come to a decisive difference: the view of the unconscious.

In 1955 Bohr sent his text the *Unity of Knowledge* to Pauli. It had been broadcast in October 1954 on the occasion of the bicentennial of the University of Columbia. Here the words 'the subconscious' and 'psychoanalysis' suddenly appear. Does this mean that we here find an influence from Pauli and therefore from Jung? Can Bohr's increasing confidence in the fundamentality of the analogies between psychology and quantum physics be explained by the fact that Pauli may have fortified Bohr in his views?[416] This passage from Bohr's essay written in 1954, might suggest so:

> The use of apparently contrasting attributes referring to equally important aspects of the human mind presents indeed a remarkable analogy to the situation in atomic physics, where contemporary phenomena for their definition demand different elementary concepts. Above all, the circumstance that the very word 'conscious' refers to experiences capable of being retained in the memory suggests a comparison between conscious experiences and physical observations. In such an analogy, the impossibility of providing an unambiguous content to the idea of subconsciousness corresponds to the impossibility of pictorial interpretation of the quantum-mechanical formalism. Incidentally, psychoanalytical treatment of neuroses may be said to restore balance in the

[414] Pauli to Fierz, 19 Jan. 1953 [Anlage zu 1507],*PLC IV/2*.

[415] Pauli to Fierz, 3 Nov. 1948 [983], *PLC III*; 19 Jan. 1953 [1507], *PLC IV/2*

[416] Pia Skogeman states that this is indeed so. She even says that it is impossible to understand what Bohr meant without understanding Jung. Pia Skogeman, *Arketyper - psykologiska mönster i en ny världsbild* (Stockholm, 1986), 173.

> content of the memory of the patient by bringing him new conscious experience, rather than by helping him to fathom the abysses of his subconsciousness.[417]

Here one could assume that Bohr through Pauli has absorbed Jung's view of the psyche and fully accepted the analogy between the non-visualizability of the objective (collective) unconscious and the non-visual situation in quantum physics.[418] But unfortunately it is not so simple. It is true that Pauli talked with Bohr about these analogies. We find evidence of that in Pauli's correspondence. But how deeply? It does not appear as if the above-quoted passage has been influenced by Pauli. For it is only after Bohr has sent the essay to Pauli that Pauli writes him a long reply in which he sets out his attitude to psychology (originally written in English by Pauli).

> Concluding this letter, I add some remarks about your sentence on page 14 concerning the 'medical use of psychoanalytical treatment in curing neurosis'. I am quite glad about this sentence, as logic is always the weakest spot of all medical therapists, who never learned the rigorous logical demands of mathematics.
>
> Historically the word 'the unconscious' was used by German philosophers of the last century, particularly by E. von Hartmann (also E.G. Carus), developing further older allusions of Leibniz and Kant. The Psycholamarckist A. Pauly, on whom we spoke already, quoted von Hartmann in 1905 (Freud was not known to him), when he called processes of biological adaptation, already in plants, an 'unconscious judgement of the psyche of the organisms'. In this way however, only a new name was introduced, which did not explain anything. Freud was the first who made practical applications of the unconscious replacing hereby this word by 'subconsciousness', which you also apply. With this change of the word Freud wanted to emphasize that all 'contents of subconsciousness' were earlier in consciousness and had been surpressed ('verdrängt') afterwards. In this way Freud's subconsciousness was like a bag containing a finite number of objects. The purpose of the psychoanalytical treatment was therefore to make this bag again empty by upheaval of the surpression. To this restricted concept of subconsciousness C.G. Jung is, among others, in opposition since about 1913. He re-established the older word the unconscious of the philosophers emphasizing that every change of consciousness for instance in a medical treatment, also changes backwards the unconscious, which therefore can never be made 'empty of contents', only a small part of it which has ever been in consciousness. The aim of the medical treatment according to Jung and his school is therefore the establishment of a correct and sound 'equilibrium between consciousness and the unconscious', like equilibrium between two powers. This process in which this equilibrium is reached or re-established, they also call 'the assimilation and integration of the unconscious to the consciousness'.[419]

[417] Bohr, 'Unity of Knowledge', *APHK*, 77.
[418] Skogeman, 171 ff.
[419] Pauli to Bohr, 15 Feb. 1955 [2015], *PLC IV/3*, in the original English.

This passage is interesting in many ways. But to begin with we can state that Pauli here gives Bohr a fundamental lesson in the history of the term 'the unconscious'. A lesson for which Bohr thanks him in his next letter:

> In this connection, the historical information in your letter about the use of terminology by psychologists was very valuable to me, and I was glad that you on the whole sympathize with my approach.[420]

Bohr's comment that Pauli's information had been very valuable seems to imply that Bohr was not particularly familiar with the schools of depth psychology. It is certainly tempting to assume that Bohr wrote of this analogy after having picked up something from Pauli. Pauli had already written in 1950 about the relation between consciousness and the unconscious and its similarity to paradoxes found in physics.[421] More importantly Pauli had just a few months earlier (December 1954) published an essay on the *Ideas of the Unconscious*, where this comparison is drawn even more explicitly.[422] But Bohr would not have had the opportunity of reading it before writing his essay on *The Unity of Knowledge*, which also appeared in 1954. What then, is Bohr falling back on, if it is not Freud or Jung? What is confusing is the fact that Bohr uses the terms 'psychoanalysis' and 'the subconscious'. Neither Freud nor Jung employ the term 'the subconscious'; they say the 'unconscious' a fact of which Pauli seems unaware.[423] William James on the other hand, prefers the term 'subconscious' or 'subliminal'.[424] It is therefore much more likely that Bohr is taking his cue from Møller and James – not from Jung. Only a few lines earlier Bohr has referred to the psychological problem of the 'confusion of the egos', an example taken from Møller. Bohr had already drawn a parallel between the unity and non-visualizability of mental life and the situation in

[420] Bohr to Pauli, 2 Mar. 1955 [2035], *PLC IV/3*.

[421] Wolfgang Pauli, 'The Philosophical Significance of the Idea of Complementarity' (1950), *Writings on Physics and Philosophy*, eds. Charles Enz & Karl von Meyenn (Berlin, 1994), 42.

[422] Wolfgang Pauli, 'Ideas of the Unconscious from the Standpoint of Natural Science and Epistemology' (1954), *Writings on Physics and Philosophy*.

[423] It is true that Freud used the terms 'the subconscious' and 'the unconscious' as synonyms in his earliest writings (around 1893), but by 1900 he emphasised that one had to avoid making distinctions between 'under' – and 'over' – consciousness. In 1926 he concluded that it is misleading to use the term 'the subconscious'. Laplanche, Pontalis, *The Language of Psycho-Analysis* (London, 1985), 430. Despite this, the German *unbewußt* has often been translated with the English 'subconscious'. This mistranslation has become so widespread that either no distinction is perceived between the concepts unconscious and subconscious, or the concept 'subconscious' is identified with the theories of Freud, as indeed is wrongly done by Pauli in the above letter to Bohr (apart from his erroneous translation of *Verdrängung* as suppression instead of repression). Just like Freud, Jung always uses the term 'the unconscious', and was careful to emphasize the difference in meaning between the different terms. Jung considered the term 'subconscious' misleading as it either denotes what is 'below consciousness' or a 'lower', that is to say secondary, consciousness. Jung, 'On the Nature of the Psyche', *C.W.*8, §369.

[424] James, Varieties, 210.

quantum physics in 1929. The argument brings to mind James' observations on the transitive and substantive parts of the psyche.[425] What is special about the 1954 essay is that Bohr made use of the terms the 'subconscious' and 'psychoanalysis' – probably for the first and only time. On all earlier occasions when Bohr referred to the analogous situation of physics and psychology he spoke only of the human mind in terms of *consciousness*: the problem of conscious self-observation, the unity of consciousness and so on.

Many years earlier, in 1948, Pauli took up the question of Bohr's views on the relationship between physics and psychology in a letter to his colleague Markus Fierz. Pauli had just re-read Bohr's *Atomtheorie und Naturbeschreibung* and been struck by Bohr's comparison of the situation in psychology and in quantum physics. Bohr compares the apparent contrast between the continuous onward flow of associative thinking and the preservation of the unity of the personality in the psychological sphere with the suggestive analogy of the relation between the wave description of the motions of material particles, governed by the superposition principle, and their indestructible individuality.[426] As we saw earlier, this analogy goes back to James' views of the paradox of consciousness as both movement and rest or as both autonomous flow and introspective observation. The paradox lies in the fact that the content of consciousness is changing all the time and that despite this we retain the impression of continuity – of an preserved identitiy.

Pauli considered this analogy, but could not really accept it. The 'indestructible' part of the psyche was to him linked to the unconscious rather than to consciousness, whose content is constantly changing.[427] A few days later Pauli has discussed the whole matter with C.A. Meier, an analytical psychologist and a good friend of his. In the following letter to Markus Fierz he writes that it has become clear to him that Bohr's analogy is entirely based on a pure *psychology of consciousness.*

> It therefore seems to me, that Bohr's analogies, as far as they relate to the psychological (see the plan in my last letter that corresponds to these analogies), are an arbitrary construction of no deep significance. Bohr never uses the concept of the unconscious; this concept is so alien to him that he has never grasped its meaning. I also recall conversations about this. He admitted freely that dreams can be used as sources of information – all the ancients did this – but he insisted that even dreams are contents of consciousness. (On this point his position resembled what I have found in the Chinese.) To sum up I consider the viewpoint expressed in my

[425] Bohr, 'The Quantum of Action and the Description of Nature' (1929), *Collected Works of Niels Bohr*, 215.

[426] Bohr, 'Atomtheorie und Naturbeschreibung', (Berlin, 1931), Aufsatz III, corresponding to 'The Quantum of Action and the Description of Nature'.

[427] Pauli to Fierz, 30 Oct. 1948 [982], *PLC III*, 575.

> essay an essential modification and amplification of Bohr's analogies regarding physics-psychology, which results from 'accepting the concept of the unconscious', as used by modern psychologists of Jungian and other persuasions.[428]

Pauli asserts that Bohr's main argument against psychologists who work with the 'unconscious' is that they do not put the actual moment of observation in focus, where each observation creates a new phenomenon and changes both the observed and the observer in an irreversible manner. The unconscious easily becomes – just like the field concept of classical physics – a metaphysical concept that exists independently of our observation and whose qualities acquire an a priori character. Here we find exactly the same criticism as William James and Harald Høffding levelled against the concept of 'the unconscious'. James preferred to talk about 'altered states of consciousness', 'fringe of consciousness' and so on.[429] For a concept to be valid and to express a real relationship it must in itself potentially encompass the irrational intervention and its consequences that *observation* constitutes. Here again we recognize James'/Høffding's positions: knowledge is not only knowledge of an object, but also knowledge of the conditions in which the knowledge is gained. As Pauli shared Bohr's view of the significance of the moment of observation, it became important to him to emphasize those parts of Jung's psychology that deal with the role of observation and its influence on the relationship between consciousness and the unconscious. Pauli stresses this point much more than Jung himself – that every change in consciousness in connection with clinical treatment also has repercussions on the unconscious.

There remains the mystery of why Bohr uses the terms 'the subconscious' and 'psychoanalysis' in his essay *Unity of Knowledge* from 1954. These terms cannot at any rate be said to form an integral part of Bohr's general vocabulary. The difference in approach to psychology, Bohr's emphasis on the paradoxes of consciousness and Pauli's stress on the importance of the unconscious become decisive in their confrontation concerning the role of *the detached observer*.

[428] Pauli to Fierz, 3 Nov. 1948 [983], ibid., 575–76.
[429] James, *The Principles of Psychology*, 166–168.

The Detached Observer

When in 1955 Bohr sent Pauli the essay on *Unity of Knowledge*, Pauli immediately noticed the following sentence: 'The notion of complementarity does in no way involve a departure from our position as detached observers of nature…'[430] Pauli had in the summer of 1954 published a revised version of his 1952 lecture entitled 'Probability and Physics', in which he describes the approach of Einstein and of classical physics as 'the ideal of the detached observer'.[431] He is therefore surprised when Bohr, who represents the position of modern physics, endorses this 'classic' ideal. Troubled, he writes to Bohr to clarify what he sees as the main difference between a classical and a modern approach:

> To put it drastically the observer has according to this [classical] ideal to disappear entirely in a discrete manner as hidden spectator, never as actor, nature being left alone in a predetermined course of events, independent of the way in which the phenomena are observed. 'Like the moon has a definite position' Einstein said to me last winter, 'whether or not we look at the moon, the same must also hold for the atomic objects, as there is no sharp distinction possible between these and macroscopic objects. Observation cannot *create* an element of reality like a position, there must be something contained in the complete description of physical reality, which corresponds to the *possibility* of observing a position, already before the observation has been actually made.' I hope, that I quoted Einstein correctly; it is always difficult to quote somebody out of memory with whom one does not agree. It is precisely this kind of postulate which I call the ideal of the detached observer.
>
> In quantum mechanics, on the contrary, an observation hic et nunc changes in general the 'state' of the observed system in a way not contained in the mathematically formulated *laws*, which only apply to the automatical time dependence of the state of a *closed* system. I think here on the passage to a new phenomenon by observation which is technically taken into account by the so-called 'reduction of the wave packets'. As it is allowed to consider the instruments of observation as a kind of prolongation of the sense organs of the observer, I consider the impredictable change of the state by a single observation – in spite of the objective character of the result of every observation and notwithstanding the statistical laws for the frequencies of repeated observation under equal conditions – to be *an abandonment of the idea of the isolation (detachment) of the observer from the course of physical events outside himself.*[432]

[430] Bohr, 'Unity of Knowledge', *APHK*, 74.
[431] Wolfgang Pauli, 'Probability and Physics' (1952), *Writings on Physics and Philosophy*, 47.
[432] Laurikainen, 60; Cf Pauli to Bohr, 15 Feb. 1955 [2015], *PLC IV/3*.

Pauli compared the situation in quantum mechanics with a person who causes disorder in nature by his freely chosen experimental devices and measurement, a disorder whose unpredictable results he cannot influence. Afterwards, however, this 'disorder' can be objectively checked and verified by everybody. Bohr replied by explaining exactly what he meant when he used the term 'the detached observer'. To him it was extremely important to make a sharp distinction between the observing subject and the observed content that is to be communicated, i. e. which is to form part of the scientific data. How, otherwise, can one guarantee an objective description and scientific knowledge? The truly valuable thing that physics has taught us, says Bohr, is to be able to eliminate the subjective element in our experience. It is this ability that Bohr wishes to denote with 'the detached observer'. This particular point has nothing to do with the difference between classical and modern physics.[433]

We see here how Bohr and Pauli approach the question from very different perspectives. To Pauli the point was the relationship between subject and object and the fact that quantum physics is no longer based on a priori objective reality but that every observation forms an interaction between what is measuring and what is to be measured. In theory this is a position that agrees with Bohr's. To Bohr this entire viewpoint is included in the concept of 'physical phenomenon'. But Bohr regards the physical phenomenon as an interaction between measuring *instrument* and measured object – a whole in itself that is independent of the observer as *subject*. When Bohr uses the term 'detached observer', he means 'the observer as subjective person', not 'what is observing' in contrast to what is being observed. Pauli, on the other hand, makes no distinction between 'the subject' and the observer as a recording unit. Instead he regards all references to the experimental situation as 'information concerning the observer'.

> … I call a reference to experimental conditions an 'information on the observer' (though an impersonal one), and the establishment of an experimental arrangement fulfilling specified conditions 'an action of the observer' – of course not of an individually distinguished observer but of 'the observer' in general.
>
> In physics I speak of a detached observer in a general conceptual description or explanation only then, *if it does not contain an explicit reference to the actions or the knowledge of the observer*.[434]

Pauli does not understand how one could possibly make a distinction between measuring instrument and the concept of 'observer' in quantum physics. For

[433] Bohr to Pauli, 2 Mar. 1955 [2035], *PLC IV/3*.
[434] Pauli to Bohr, 11 Mar. 1955 [2041], *PLC IV/3*.

Pauli 'observer' does not refer to a subjective person, but to the actual setting-up of the experimental situation. To Pauli the experimental situation and the measuring instrument are directly connected to the observer, whereas Bohr makes a distinction between the observer and the phenomenon – which includes the measuring instrument.[435] To Bohr it is therefore necessary to say that the observer is detached because it is identified with something purely subjective. An inclusion of the purely subjective observer would eliminate the possibility of an objective description of the phenomena. Pauli, on the other hand, makes a distinction between 'the ideal of the detached observer' and 'the ideal of an objective description'. The fact that the observer in quantum physics has a more active role, that he is both actor and spectator in Bohr's terms, in no way makes it impossible to describe the result of this activity in an objective manner.[436] So Pauli here in fact puts a stronger emphasis on the role of description (i. e. communication) than Bohr does. For Pauli the 'observer' in science includes the perspective of the scientist. The approach of the observer can very well be *personal* without threatening the objectivity of science; science is in fact formed and shaped by personalities. But the description must be formulated in objective terms (with the help of mathematics for instance). It can, however, never be *private*. For Pauli the opposite of an objective description is not the personal but the private.[437]

As was his wont, Bohr skated over the differences between them by stating that when all is said and done he and Pauli were really in agreement on the main questions. The difference lay only in the definition of the term 'the detached observer', which to him quite simply meant the possibility of providing an objective description of observation without bringing in subjective elements, whereas to Pauli the question was one of the crucial difference between the observer's role in classical and in modern physics. Pauli was prepared to accept that this was so, but was very anxious for them to agree on a common use of language, so that readers would not be totally confused. Pauli reports on this 'mishap' in a letter to Franz Kröner, where he states that their debate on the use of the term 'detached observer' never reached a satisfactory conclusion. The result of the whole discussion was that neither Bohr nor Pauli used the term again.[438] In this case Bohr was clearly at pains to underline the continuity between classical and modern physics,

[435] Bohr to Pauli, 25 Mar. 1955 [2047], *PLC IV/3*.
[436] Pauli to Bohr, 11 Mar. 1955 [2041], *PLC IV/3*.
[437] Pauli to Fierz, 19 Jan. 1953 [1507], *PLC IV/2*.
[438] Pauli to Kröner, 30 November 1956 [2406], *PLC IV/3*.

whereas Pauli was more inclined to emphasize and accentuate the difference. Pauli was, moreover, convinced that in the future the observer would be even less 'detached' and separate than in quantum physics. In future it would become increasingly necessary to include man and the role of observation in the formulation of scientific theory.[439]

With the passing of years Bohr seems increasingly to have stressed the link between quantum physics and classical physics. In an essay written in 1958 he asserts that the complementarity perspective does not rule out the ideal of causality, and that complementarity contains no allusion to an observing subject.[440] K.V. Laurikainen believes that Bohr modified his language after coming under heavy fire from philosophers, while at the same time his earlier utterances were causing problems to the physicists of the Soviet Union. The academician Vladimir Fock stressed this particular aspect on a visit to Copenhagen in 1957. It was of the utmost importance to avoid giving the impression that knowledge of the atomic system might not be objective. The state-function must be seen as an element of physical reality, not only as a description of our knowledge of the physical system.[441] After Bohr made a few minor adjustments to his phrasing Fock was able to write in the Soviet journal *Uspekhi fizicheskikh nauk* that Bohr now accepted that causality had retained its full validity and that only the method of presenting it had changed.[442] Furthermore, Bohr had also agreed that the quantum theory describes the objective atomic world and that all previous comments could be dismissed as linguistic carelessness on Bohr's part.[443] It would therefore appear to be ideological pressure that prompted Bohr's later modification of his pronouncements on the role of the observer and the causality ideal.[444]

If we disregard any possible adjustment of Bohr's language to certain ideological requirements, there still remains a substantial difference between the viewpoints of Pauli and of Bohr. However this does not lie in differing views of the changed position of the observer, but rather in a diverging view of the concept of 'observation'. Bohr took up this point himself in his letter to Pauli. To Bohr, observation was simply '… a recording which is unambig[u]ously communicable in common language without requiring

[439] Pauli says '… the degree of this ›detachment‹ is gradually lessened in our theoretical explanation of nature and I am expecting further steps in this direction.' Laurikainen, 60; cf Pauli to Bohr, 15 Feb. 1955 [2015], *PLC IV/3*.

[440] Bohr, 'Atomphysik und Philosophie - Kausalität und Komplementarität' (1958), *Atomphysik und menschliche Erkenntnis*, 110.

[441] Laurikainen, 163.

[442] Ibid.

[443] Ibid., 59.

[444] Ibid., 71.

any further creative treatment.'[445] Pauli had, however, with his interest in Jung, obtained a very different picture of observation. It consists not only of recordings of interactions with an external environment but also to an equal extent of a creative process.

The real difference between Bohr and Pauli was that Bohr basically employed a fairly simple model of perceptual psychology, in which consciousness is still seen as a 'recording' level. Instead of the objective a priori reality that one is assumed to record in classical physics, what is recorded in quantum physics is the physical phenomena that constitute an indivisible whole of measuring instrument and object. Every instant of observation creates a new fact, of course, but this fact can then be recorded in an unproblematic manner. The analogy with the relationship between subject and object in psychology is only in the common epistemological situation. The subject as a *qualitative* factor has no place in Bohr's model.

[445] Bohr to Pauli, 25 Mar. 1955.

Rational and Irrational

As 'the irrational' plays a large part in the intellectual climate of the turn of the century and the inter-war years, and is to some extent pivotal to my study, it is important to look more closely at how this concept is used. In our day it has acquired an increasingly pejorative connotation. It is associated with something abhorrent to reason and 'anti-intellectual'. It is used to label and dismiss views, which do not fit into our perception of reality. It is seen as something 'dangerous'. In certain circles the concept *mysticism* has also suffered the same fate. In our modern historiography it has become routine to link an interest in the mystical, symbolic and mythological with a preliminary stage of Nazism. At the same time it is often forgotten that the Nazis usually regarded representatives of symbolic thinking and perspective, for example modern art, as degenerate. Their work was labelled *entartete Kunst* whereas the Nazis preferred the 'new objectivity' (*Neue Sachlichkeit*), a kind of hyperrealism. New physics, with its relativity, acausality, abstract mathematics and uncertainty relationship, was dismissed as Jewish physics. Instead the Nazis extolled the German, rationally utilitarian physics, based on the classical, determinist view of the world.[446]

What, then, is the irrational? As a concept it is defined from the outset in relation to the *rational* and therefore its meaning naturally comes to depend on that. The definition of the rational has changed in the course of history. To Plato, for example, the rational was identical with the innermost and true essence of existence, the world of ideas, and with that the irrational automatically fell into the category of the non-real.[447] Plato also regarded the impressions of the senses and physical reality as irrational. Our sensory perceptions can only give us unordered and contradictory information. This definition of the irrational, i. e. linked to the life of the body, has survived. Instincts, drives, feelings and sensations are regarded at worst as contrary to reason and reprehensible.

Another tradition is that of regarding the irrational as something that *precedes* and forms the basis for the rational. In the extension of this per-

[446] Johannes Stark, 'The Pragmatic and the Dogmatic Spirit in Physics', *Nature* 141 (1938), 770–772.
[447] Harold Cherniss, 'The Sources of Evil According to Plato', *Proceedings of the American Philosophical Society* 98 (1954), 24.

spective the irrational may be regarded as whatever is directly given to us: elementary facts and phenomena, which have not yet been incorporated in a theory or grasped by consciousness. However there is a third definition of the irrational that also dates back to our Greek inheritance. This definition is connected with the Pythagoreans' discovery that the intervals on the harmonic scale represent simple, full-number proportions of the lengths of musical strings. The rational (*logos*) was then linked with numerical ratios and proportions, which were also used in geometry. It was also discovered that unfortunately there are elements in a geometric figure that *cannot* be determined in whole-number ratios. They remain inexpressible and can only be given an approximate value. Irrational numbers can only be expressed with the aid of an infinite number of decimals. From this point of view the rational acquires the meaning of something that can be exactly determined, something that can be encircled and defined, whereas the irrational is that which transcends what can be grasped, that which is boundless rather than finite.[448] Pauli stressed the importance of the 'irrational'. According to Pauli, the main reason for our one-sided view of the world is that we lack understanding of the irrational. One might imagine that Pauli's perspective derives only from his interest in Jung. But Pauli refers just as much back to Niels Bohr and the development of physics in this respect. Let us examine this a little more closely.

The concept 'irrational' occurs quite often in Niels Bohr's early writings. To begin with he used the concept to describe the quantum of action in relation to classical physics.

> Especially had the great success of Schrödinger's wave mechanics revived the hopes of many physicists of being able to describe atomic phenomena along lines similar to those of classical physical theories without introducing 'irrationalities' of the kind that had thus far been characteristic of the quantum theory. In opposition to this view, it is maintained in the article that the fundamental postulate of the indivisibility of the quantum of action is itself, from the classical point of view, an irrational element which inevitably requires us to forego a causal mode of description and which, because of the coupling between phenomena and their observation, forces us to adopt a new mode of description designated as *complementary* in the sense that any given application of classical concepts precludes the simultaneous use of other classical concepts which in a different connection are equally necessary for the elucidation of the phenomena.[449]

In his article *Light and Life* in 1933 he again uses the concept 'irrational'.

[448] Gerhard Huber, 'Zur kategorialen Unterscheidung von ›rational‹ und ›irrational‹', *Der Pauli-Jung Dialog*, 9–19.

[449] Bohr, 'Introductory Survey', *Collected Works of Niels Bohr*, vol. 6, 288.

> On this view, the existence of life must be considered as an elementary fact that cannot be explained, but must be taken as a starting point in biology, in a similar way as the quantum of action, which appears as an irrational element from the point of view of classical mechanical physics, taken together with the existence of elementary particles, forms the foundation of atomic physics. The asserted impossibility of a physical or chemical explanation of the function peculiar to life would in this sense be analogous to the insufficiency of the mechanical analysis for the understanding of the stability of atoms.[450]

It is interesting that Bohr chooses to publish another version of this lecture in the English edition of the anthology *Atomic Physics and Human Knowledge* in 1958, in which this passage does not contain the word 'irrational'.[451] When in his early texts Bohr used the concept 'irrational', he did so in the sense of 'an elementary fact', which cannot be further reduced to any determinable constituents. The quantum of action appears irrational only in relation to the requirements of classical physics i. e. that both position and energy of the particle have to be exactly definable. The quantum of action is therefore not 'irrational' in the sense of 'mystical' or 'undeterminable' because the quantum itself is very precisely defined. If the classical perspective is replaced with a complementarity perspective, then the quantum of action finds its logical and well-defined place in the *rational generalization* of classical mechanics by quantum mechanics. This is probably why Bohr stopped using the term 'irrational' and instead emphasized the holistic features and indivisibility of the quantum phenomena and the complementary character of the figurative (wave-particle) presentations.

Pauli, on the other hand, continued to use the concept 'irrational'. He wished to emphasize the relationship between the *unpredictable actuality* of the moment of observation (measurement) and the abstract rational order of possible observations, which is represented by the mathematical concept of probability (superposition).[452] The unique result of measurement is as such irrational, but it is rationalized by incorporation into a statistical model that obliterates the significance of the individual moment of observation. This was an enormously important point to Pauli. He saw it as the actual watershed between the classical and the modern (quantum mechanical) view of the world, a view of the world that he regarded as the culmination of the whole Graeco-Western history of science. The relationship between irrational (acausal) reality and rational (causal) probability reflects the classical questions of the nature of our knowledge.

[450] Idem, 'Light and Life', *Nature* 131 (1933), 458.
[451] Idem, 'Light and Life' (1932), *APHK*, 9.
[452] Pauli, 'Probability and Physics', *WPP*, 46.

Just like Bohr, Pauli used the concept 'irrational' to designate an elementary fact, i. e. a phenomenon that is not capable of further reduction (just-so-ness). As Jung's definition of the irrational agrees with this, he could also accept it openly.[453] Jung defines the 'irrational' as denoting something *beyond* reason but not something *contrary* to reason. Elementary facts come into this category, i. e. facts that are not grounded on reason. The irrational is something that can be pushed further and further out of sight by rational explanation, but always ends up at the limits of rational thought. A completely rational explanation of reality is a Utopian ideal, never to be reached. Only an object that is posited can be completely explained on rational grounds, since it does not contain anything beyond what has been 'put into it'. Empirical science always singles out those parts of an actual object that will be chosen for rational observation and deliberately excludes other parts, which are considered accidental.[454]

A phenomenon is always irrational *in relation* to something else. If the phenomenon can be reduced to or placed within the framework of a rational explanatory model it ceases to be irrational. The irrational is always what transcends our models of reality. For that reason Jung linked the irrational with the originally given, while rational reason is really an expression of man's historical adaptation to average occurrences. These average experiences have gradually condensed into stable and organized complexes of conceptions that have been attributed with objective value. From that perspective the rational is the function, which builds up general and culturally habitual patterns of thinking. Everything that agrees with this consensus is considered rational; everything that deviates from it is seen as irrational.[455] The irrational is what falls outside our gaze. As no worldview or theory can be all-embracing, the irrational will always represent the boundary of our knowledge.

We find the same argument in Hertz, Wittgenstein and Gödel, who stated that a fully rational language or a closed logical system cannot say anything beyond itself. The relationship with something outside this system immediately introduces an 'irrational' or logically non-determinable element. The relationship between language and reality 'shows itself', said Wittgenstein, and a complete system is not free from contradiction, according to Gödel. The rational can only exist as a sub-system in relation to something greater, which is irrational. Harald Høffding used the term irrational in exactly the same sense. He said that the relationship between reality and logical idea is

[453] Pauli to Jung, 27 Feb. 1953 [58P], *PJL*, 91ff.
[454] Jung, 'Psychological Types', *C.W.*6, §774–775.
[455] Jung, 'Psychological Types', *C.W.*6, §786.

irrational. The idea can only grasp part of reality but we use this part to try to understand the whole. The irrational relation between these two – idea and reality – should be understood in its mathematical sense, according to Høffding.[456] This means that reality – like an irrational number – can never be exactly determined from our logical concepts or ideas. Reality is always something *more* and that is why this irrational relationship between idea and reality is also the precondition for progress and development. Reality and life enrich and constantly change our knowledge.[457] In this argument we can see a clear parallel with Bohr's viewpoint. Even if Bohr seldom uses the term 'irrational' to describe the relationship between language and reality, he understands it in exactly the same way. Oskar Klein quotes Bohr when he speaks of the 'irrationality, which every analysis of a question, if driven far enough, reveals in existence, an irrationality which means that even the strictest and clearest presentation of a subject is ultimately no more than a painting in words.'[458] The logically clear and exact can never deliver the totality of reality. That is why truth dwells in the deeps. The irrational is therefore that which transcends the rational, that which goes 'beyond'.

Pauli tried to penetrate the depth of this question and sought a positive way of expressing the irrational, which in itself represents a term that is defined by what it *is not*. He particularly developed these ideas in relation to Jung's principle of synchronicity. He stated that because the models of science necessarily build on the possibility of making general statements; they are dependent on testability by repetition. This, of course, excludes from the very beginning any reference to something *unique*. Pauli's goal was to find his way to a worldview that was open enough to include the irrational, a model of reality that could actually incorporate the *qualitatively unique*.

[456] Høffding, 'Philosophy and Life', 146.

[457] Ibid., 149–151.

[458] Klein, 'Niels Bohr som tänkare', 413. David Favrholdt claims that Høffding and Bohr use the term 'irrational' in two entirely different ways. He argues that to Høffding 'irrational' merely means 'incomprehensible', whereas Bohr uses it exclusively to describe a phenomenon which is in conflict with classical physics. Such a demarcation line has to be regarded as a gross oversimplification. Favrholdt, 110.

Pauli and Jung

Pauli's Life Crisis

Pauli and Jung first met in 1931, when Pauli sought help for acute depression. Pauli says in a much later letter to Jung that his neurosis had already been quite apparent in 1926, while he was living in Hamburg. His exclusive preoccupation with scientific interests had suppressed all other human qualities and in particular harmed his emotional life. An expression of this was the vivid contrast between light and dark in his personality and in his relationships with women. He developed a classical Dr. Jekyll and Mr. Hyde personality: on the one hand he was the super intelligent famous 'conscience of Science', on the other an alcoholic ruffian who frequented bars and often got into fights. He felt lonely and had the impression that everybody was against him.[459] Pauli also had at this time a very prejudiced view of women. Women should keep out of science: the few who entered the field either did so only to find successful husbands or became transformed into unwomanly, ice-cold monsters.[460] This scorn for women was in contrast with his total emotional dependence on them.[461] This condition worsened considerably after the suicide of Pauli's mother in 1927. He had had a positive relationship to her and hated his father. This hatred was now intensified and focused on both the father and the younger woman whom he had married. In the light of Jung's psychology, Pauli gradually understood that his contempt for women was based on the repression and projection of a part of his own personality, his 'dark' feminine side (to use Jung's term, his *anima*), which had not been allowed to develop.[462] The 'dark anima' manifested as the prostitute in Pauli's

[459] Pauli to Jung, 24 May 1934 [30P], and 23 Oct. 1956 [69P], 'Statements by the Psyche', *PJL*, 27, 151; Jung, 'Tavistock', *C.W.*18, §402.

[460] Pauli retained some of this attitude all his life. He describes Eve Curie (the daughter of Marie Curie) in these terms. Pauli to Delbrück, 6 Oct. 1958 [3075], *PLC IV/4ii.*

[461] See, for example, Pauli to C.A. Meier, 25 Feb. 1942, unpublished, (will appear in *PLC suppl.*).

[462] Jung called the female sides of the male 'anima'. As a result of the male's adaptation to his own gender role, to the demands of society, to his professional role etc (Jung calls this the development of a persona), these female sides are pushed into the background. They then emerge in the form of a personified figure in the unconscious with specific compensatory character features. If the persona is intellectual, the anima is sentimental. It represents the sides which the male has not developed in himself and often appears in the form of various states of affect. Anima is usually projected onto the opposite sex, but she also appears as an internal guide or soul-image. As she embodies those parts of the male's own personality which he has not developed, the fascination with anima also represents, in extension, the longing for wholeness and union. Anima can therefore very well be projected onto science, art and religion. Jung, 'Aion', *C.W.9 II,* §20 ff.

night life. The light part of the anima had successfully been contained in his scientific pursuit, while the higher part of his personality, the Self, had been projected unto his physics teachers.[463] During his analysis Pauli devoted most of his efforts to expanding his neurotic and one-sided intellectual personality. A large part of the work involved differentiating and integrating his anima. As for many other men, this meant maturing emotionally and developing a more balanced relationship to sexuality and women. When Pauli had worked through this basic side of his anima problem, however, he noticed that this set of eroto-sexual problems hid something much larger – a totally different way of looking at reality.[464]

With Pauli's permission Jung later published parts of the material from the analysis. There he presented Pauli as an intellectual young man of striking intelligence who had sought Jung's help because his neurosis had gained control of him and gradually undermined his morale.[465] In February 1932, Pauli began to undergo analysis with a female pupil of Jung's, Dr. Erna Rosenbaum, a novice at the time. She is described as 'a young Austrian, pretty, fullish, always laughing'.[466] Pauli wrote her a letter introducing himself and the circumstances on 3 February 1932. He informed her that Jung had quickly passed him a note with her name and address on after a lecture that Pauli had attended. A week earlier he had consulted Jung about certain neurotic phenomena that were also linked to the fact 'that success in the academic world comes more easily to me than success with women. As it is the other way around with Mr. Jung, he seemed to me the right man to give me medical treatment.'[467] Jung was obviously of another opinion and told Pauli that this female analyst was chosen because of his problems with women.[468] Elsewhere Jung explains the decision not to treat Pauli himself. Because of Pauli's extraordinary personality and the fact that he seemed to be 'chock-full of archaic material' he wanted to make 'an interesting experiment' and ensure that his development proceeded without any personal influence from Jung's part. In this way he would 'get that material absolutely pure' and receive 'as objective a process' as possible.[469] The task of

[463] See Pauli to von Franz, 21 August 1953 [1625], *PLC IV/2*.

[464] See, for example, Pauli to C.A. Meier, 26 May 1942, unpublished (will appear in *PLC suppl.*).

[465] C.G. Jung, 'Psychology and Religion' (1940), *C.W.*11, §38.

[466] Pauli to Jung, 2 Oct. 1935 [13P], Pauli to Jung, 27 May 1953 [62P], *PJL*, 10, 121; Enz, *No Time to be Brief*, 240.

[467] Karl von Meyenn, 'Paulis philosophische Auffassungen' in *PLC IV/2*, XXIII.

[468] *PJB*, footnote, 9 (not in the English version).

[469] C.G. Jung, 'Psychology and Alchemy', *C.W.*12, §45, 'The Tavistock Lectures', *C.W.*18, §402. Pauli's second wife, Franca Bertram, whom Pauli married after completing his analysis considered this a frivolity on Jung's part. See Enz, Charles, 'Wolfgang Pauli and Carl Gustav Jung' in *Wolfgang Pauli and Modern Physics*, ed. ETH-Bibliothek, ETH Zürich (Zürich, 2000), 73.

Pauli at the time for his first meeting with Jung[470]

the doctor was for the most part just 'to observe the process'. In addition to their regular appointments Pauli – true to form – wrote long letters to his analyst, even excusing himself for writing so much. He was apparently satisfied with this arrangement, he felt no need to meet his analyst more frequently. 'Somehow it now functions smoothly by itself – so it seems to me – and I do not need too much enlightenment at present'.[471] After five months Dr. Rosenbaum moved to Berlin, and contact was kept by correspondence only for another three months. The greater part of this analytical work consisted in writing down and reporting dreams, which were then passed on to Jung. Jung makes a point of mentioning that he did not meet Pauli at all during the first eight months of his therapy. Thus 355 out of a thousand dreams over a ten-month period were dreamed without any contact with him. Nor was there any need for interpretation of the dreams, thanks to 'the dreamer's excellent scientific training and ability', as Jung puts it. Jung found it important to add that Pauli's educational background was not historical, philological, archaeological or ethnological and that all references to material from these fields had come to the dreamer from the unconscious![472]

[470] Wolfgang Pauli in Potresina, Winter 1931/1932, Photo No. PAULI-ARCHIVE-PHO-034, courtesy *CERN-archive*, Geneva.

[471] Enz, *No Time to be Brief*, 241

[472] C.G. Jung, 'Psychology and Alchemy', *C.W.*12, §45.

As mentioned above a selection of dreams and fantasy material from Pauli's analysis was then included in Jung's lectures on the symbolic manifestations of the individuation process.[473] The material was first made public in a lecture at the Eranos Conference of 1935 and again a few years later in the *Terry Lectures*, given at Yale University in 1937. The lectures were enlarged and eventually published under the titles *Psychology and Alchemy* and *Psychology and Religion*.[474] At Pauli's request his identity was not revealed.[475] There is no surviving correspondence between Pauli and Jung during the war years 1941–45 and it is most probable that they did not write to each other during this time. Pauli resumes the correspondence in October 1946, while the discussions reach their most intensive in 1950, 1953 and 1957. It is difficult to decide what the personal relationship between Pauli and Jung was like. The letters bear witness to mutual respect and sympathy. In a recent biography of Jung their relationship is singled out as having occupied a unique position in Jung's mature intellectual life. Pauli is said to have been Jung's only friend 'who enriched Jung's thinking and broadened his outlook'.[476] We get a fairly good impression of Pauli's reading of the works of Jung from Pauli's library, donated to the CERN and kept in 'La Salle Pauli'. There we find seventeen works by Jung, most of them containing marginal notes by Pauli. This list is not complete, however; for example, essays by Jung that were published in the Eranos Yearbooks need to be added. Jung's book *Wandlungen und Symbole der Libido* (The Psychology of the Unconscious, later Symbols of Transformation) contains many notes, but is never discussed by Pauli in his letters. This was probably the first book he read by Jung before they met and he started his analysis.[477]

[473] The greater part of this material – over 1000 dreams – is still medically confidential and is not available for research.

[474] Cf C.G. Jung, *C.W.*11 and 12.

[475] Pauli to Jung, 2 Oct. 1935 [13P], *PJL*, 10.

[476] Deirdre Bair, *Jung: A Biography* (Boston, 2003), 554–555.

[477] *Wandlungen und Symbole der Libido* (Leipzig, 1925), 61 pages marked.
Das Unbewusste im normalen und kranken Seelenleben (Zürich, 1926), 3 pages marked.
Die Beziehung zwischen dem Ich und dem Unbewussten (Zürich, 1928), 47 pages marked.
Über die Energetik der Seele (Zürich, 1928), no markings.
Das Geheimnis der goldenen Blüte (with Richard Wilhelm), (München, 1929), 53 pages marked.
Psychologische Typen (Zürich, 1930), 107 pages marked.
Seelenprobleme der Gegenwart, Psychologische Abhandlungen bd 3 (Zürich, 1931), 47 pages marked.
Wirklichkeit der Seele, Psychologische Abhandlungen bd 4 (Zürich, 1934) 9 pages marked.
Psychologie und Religion: The Terry Lectures 1937 (Zürich, 1940), 11 pages marked.
Psychologie und Alchemie (Zürich, 1944), 2 pages marked.
Aufsätze zur Zeitgeschichte (Zürich, 1946), no markings.
Symbolik des Geistes, Psychologische Abhandlungen bd 6 (Zürich, 1948), 19 pages marked.
Gestaltungen des Unbewussten, Psychologische Abhandlungen bd 7 (Zürich, 1950), 52 pages marked.

According to Jung's colleague Marie-Louise von Franz, Pauli was never analysed by Jung himself. She says:

> . . . he did have a few interviews with Jung. Pauli was in analysis with an English woman, Dr. Rosenbaum. His dreams during that analysis were dreams of psychology and alchemy. This was several years prior to his time in Zürich. When he married and moved to Zürich to assume a professorship, he did not re-enter analysis. But, as I said, he occasionally had an interview with Jung.[478]

This statement is not at all consistent with certain known facts.[479] Pauli obtained his professorship at ETH in 1928. He began his analysis with Dr. Rosenbaum in February 1932 and this is also the date of the first surviving letter to Jung.[480] Whether Pauli's regular visits to Jung in 1932–34 can be described as 'occasional interviews' is also questionable. The correspondence between Pauli and Jung indicates that they had regular appointments, and Pauli himself calls his visits to Jung 'dream interpretation and dream analysis'.[481] The question of whether Pauli had proper 'analysis' with Jung is however subject to debate. When I interviewed C.A. Meier on April 6, 1993, he too told me that Pauli's meetings with Jung cannot be regarded as regular analysis. According to him their meetings were infrequent, perhaps no more often than once a month.[482] In the recent English translation of the correspondence we equally find two opinions voiced: one in the introduction by Beverly Zabriskie ('Jung and Pauli [. . .] later met, not for analysis but for a comparison of ideas') and the other by the 'editors' – as far as I can see this would be Dr. James Donat ('Erna Rosenbaum saw Pauli for five months, after which Pauli had self-analysis for three months. Jung then took over analysis for two years.').[483]

In April 1934 Pauli married Franziska (Franca) Bertram (1901–87) in London. They had met in 1933 at the home of a mutual friend, Adolf Guggenbühl, who was having a housewarming party. Franca Bertram originally came

Aion: Untersuchungen zur Symbolgeschichte mit einem Beitrag von Dr. phil. Marie-Louise von Franz (Zürich, 1951), 49 pages marked.
Mysterium Coniunctionis Band 1 (Zürich, 1955), 37 pages marked.
Mysterium Conjunctionis, Band 2 (Zürich, 1956), 32 pages marked.
Mysterium Conjunctionis, Band 3, Aurora Consurgens (Zürich, 1957), 5 pages marked.
A book without markings does not necessarily mean that Pauli did not read it. The work *Über die Energetik der Seele* was for instance cited in Pauli's essay 'Ideas of the Unconscious from the Standpoint of Natural Science and Epistemology'. For details of which pages contain markings I refer to the register at CERN compiled by the author.

[478] 'Love, War and Transformation: An Interview with Marie-Louise von Franz by Charlene Sieg', *Psychological Perspectives* 24 (1991), 56.

[479] In an interview which I had with Marie-Louise von Franz on 13 March 1993, she admitted that she did not know that Pauli and Jung had met regularly.

[480] Pauli to Jung, 2 Oct. 1935 [13P], *PJL*, 10.

[481] Jung to Pauli, 19 Oct. 1933 [3J], *PJL*, 3; Pauli to Jung, 26 Oct. 1934 [7P].

[482] Taped interview with C.A. Meier, 6 April 1993, private possession.

[483] *PJL*,xxxv and 5.

from Munich but had travelled widely. At the time she was working as a manager of a Russian orchestra.[484] In October 1934 Pauli wrote to Jung that he wanted to break off his analysis. As far as I can see, then, Pauli was in analysis from 1932–34, first with Dr. Rosenbaum, and later with Jung himself. The evaluations of Pauli's analytical treatment also diverge. Jung considers that he became 'perfectly normal and reasonable', while von Franz and others claim that he soon began drinking again.[485] When terminating analysis in 1934 Pauli admits he still has some unsolved problems, particularly on the emotional side. However he considers that he can only develop and mature in contact with real life and not as a result of analysis of dreams alone. Pauli felt that he was more stable and harmonious and that he was functioning better in his personal relations. He felt a need to get away from everything to do with analysis and the interpretation of dreams, in order to find out what life outside had to offer.[486] Some say that Franca Pauli might have persuaded him to quit analysis while Franca's own version is that Jung turned his back on Wolfgang when he decided to marry her. Jung reacted brutally, he turned completely away from Pauli. This was catastrophic for him, on a skiing trip with Franca in December 1934 he suddenly exclaims that the earth is shaking and that he wants to thrash someone.[487] In view of Franca Pauli's extremely critical attitude to Wolfgang's involvement with Jung, Jung's very positive letter on the occasion of their marriage and Pauli and Jung's continuous contact, I view Franca Pauli's version with a grain of salt. Pauli also used to recount his dreams to his wife. She found them 'embroidered' *(frisiert)* and said that 'dreams aren't that pretty'.[488] We have also a report from late September 1935 written by Pauli's close friend Ernst Hecke to Herman Weyl, where Hecke expresses worries concerning Pauli's health. He seems excessively preoccupied with his dreams, to the extent that no other human experiences seem to reach him. Hecke feels sympathy for Franca Pauli and 'the huge piece of work' she has with a man like Pauli. Herman Weyl states that Franca Pauli must be the best thing that ever happened to Pauli, especially because she has put a definitive end to Pauli's excessive involvement with Jung's psychology.[489] In a letter shortly before his death

[484] Enz, *No Time to be Brief*, 284 ff.

[485] Jung, 'The Tavistock Lectures', *C.W.*18, §405; 'Letter to the Editor from Marie-Louise von Franz', *Psychological Perspectives* 20 (1988), 377; 'Love, War and Transformation: An Interview with Marie-Louise von Franz by Charlene Sieg', *Psychological Perspectives* 24 (1991), 56; Peat, David, *Synchronicity: The Bridge Between Matter and Mind* (Toronto, 1987), 21.

[486] Pauli to Jung, 26 Oct. 1934 [7P]; 22 Jun. 1935 [9P]; 28 Feb. 1936 [16P], *PJL*.

[487] Enz, *No Time to be Brief*, 248, 287.

[488] Enz, Charles, 'Wolfgang Pauli and Carl Gustav Jung', 74.

[489] Karl von Meyenn, 'Paulis philosophische Auffassungen' in *PLC IV/2*, XXIII f.

Pauli admits the important role his wife played in his recovery and in his improved relationships with women.[490]

One aspect of Pauli's 'anima problem' was his relationship with Jung's pupil Marie-Louise von Franz. They got to know each other in 1947 and she helped Pauli with the translation of Kepler and Fludd. Their relationship changed character around 1951 and developed into a more personal and passionate one, at least on Pauli's side. The intensification of their relationship seems to have started in 1951 in connection with von Franz'

work on the dreams of Descartes, on which Pauli made extensive comments. She had hoped to publish this work together with Jung's essay on synchronicity and Pauli's Kepler article in the volume *Naturerklärung und Psyche*. Jung was in favour of the idea but Pauli opposed it, which was of course a big disappointment to her.[491] They had a common background in the fact that they both had their roots in Austria. Pauli also felt that they both belonged to the same personality type (according to Jung's typology, see below), i. e. the thinking type.[492] This he also saw as part of their problem of relating to each other, as the feeling function for both belonged to their inferior side. Pauli felt quite unsure and described their relationship as two people sitting in a car that neither of them can drive. When it came to feelings Pauli says: 'There I am no celebrity, but undeveloped, maybe even infantile'. It is clear from the letters that they had some kind of 'crush' (or transference in a psychological language) on each other and that Pauli tried to direct these feelings in a more intellectual direction.[493] 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.[494] Relations

[490] Pauli to Delbrück, 6 Oct. 1958 [3075], *PLC IV/4ii*; Karl von Meyenn, 'Paulis philosophische Auffassungen', *PLC IV/2*, XXIII f.

[491] Pauli to von Franz, 8 August 1951 [1270], footnote 2. See also Pauli to von Franz, 31 January 1951 [1197], 22 February 1951 [1205], 13 December 1951 [1325], 16 December 1951 [1326], 22 December [1328], *PLC IV/1*. See also von Franz, 'The Dream of Descartes' in *Dreams* (Boston, 1991).

[492] More precisely he considered himself to belong to the introverted thinking/intuitive type while he regarded sensation in combination with feeling his inferior functions. The centre of gravity among the functions shifted from the dichotomy thinking/feeling in his younger years to intuition/sensation later in life. In 1956 he considered his most inferior function to be extraverted sensation, i. e. the relationship to practical reality. He made personal associations between the functions and countries, as for instance thinking=Germany, intuition=England, feeling=France and sensation=Italy. Pauli to Jung, 'Statements by the Psyche', 23 Oct. 1956 [69P], 137–137, *PJL*. See also Pauli to Jaffé, 6 Dec. 1950 [1176], *PLC IV/1*.

[493] Pauli to von Franz, 5 March 1951 [1209] and 18 April 1951 *PLC IV/1*.

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

between them were problematic and seem to have culminated in the autumn of 1955. Von Franz describes him as preoccupied with himself and unwilling to engage in a real dialogue. He wanted a free analysis of his dreams, he even thought of his dreams as fabulous gifts from him to her. After all he was the special dreamer that had been elected by Jung for his studies in *Psychology and Alchemy*. He wanted them analysed, not as part of a therapy but as a form of 'philosophical dialogue'. He therefore refused to supply von Franz with associations and other important material to make an interpretation possible.[495]

Pauli sent her many dreams and dedicated two 'active imaginations' to her, i. e. fantasies written as a dialogue with the unconscious.[496] The first was one he had written in 1942, before they even met, but he sent it for her birthday in December 1952. It is called *The Battle of the Sexes* (*Der Kampf der Geschlechter*) and is a fictitious dialogue between Immanuel Kant and Aphrodite. He calls it a philosophical comedy and it deals with the conflict of intellect and feeling within himself. The main theme concerns whether there exist any objective criteria for ethics based on reason or if ethics is a question of differentiated feeling. Kant and Aphrodite conclude that they both need one another.[497]

The other is from 1953 and is called *The Piano lesson*. It starts with a foggy day and Pauli having trouble bringing two schools together, the *old* school that understands words but not meaning and the *newer* one that understands meaning and not his words (physics and depth psychology). Thereafter the voice of the 'master' sounds and says '*time reversal*'; paper cones appear 'with the summit downward'. The cones are 'the images of the Master' (archetypal

[495] Taped interview with Marie-Louise von Franz on March 13, 1993.

[496] Jung describes 'active imagination' as 'a method (devised by myself) of introspection for observing the stream of interior images. One concentrates one's attention on some impressive but unintelligible dream-image, or on a spontaneous visual impression, and observes the changes taking place in it. Meanwhile, of course, all criticism must be suspended and the happenings observed and noted with absolute objectivity. Obviously, too, the objection that the whole thing is 'arbitrary' or 'thought up' must be set aside, since it springs from the anxiety of an ego-consciousness which brooks no master besides itself in its own house. [–––] The advantage of this method is that it brings a mass of unconscious material to light. Drawing, painting, and modelling can be used to the same end. Once a visual series has become dramatic, it can easily pass over into the auditive or linguistic sphere and give rise to dialogues and the like. With slightly pathological individuals, and particularly in the not infrequent cases of latent schizophrenia, the method may, in certain circumstances, prove to be rather dangerous and therefore requires medical control. It is based on a deliberate weakening of the conscious mind and its inhibiting effect, which either limits or suppresses the unconscious. The aim of the method is naturally therapeutic in the first place, while in the second it also furnishes rich empirical material. Some of our examples are taken from this. They differ from dreams only by reason of their better form, which comes from the fact that the contents were perceived not by a dreaming but by a waking consciousness.' Jung, *C.W.9I*, §319.

[497] Pauli to v. Franz, 4 Jan. 1952 [appendix to 1335], *PLC IV/1*.

images produced by the *Self*) where the different layers of paper represent different layers of time, i. e. epochs of Pauli's life (the cones are also analogies to the light cones of the four-dimensional Minkowski space-time world and also of the multi-leafed Riemann surface). On one layer he visits Marie-Louise von Franz in the present and on the other he is in Vienna in 1913. He is once again a schoolboy holding a folder of music in his hand entering a house where a very distinguished lady leans against an old grand piano. The black-haired lady seems like a familiar old friend. She extends her hand and says 'You haven't played the piano for a long time. I want to give you a piano lesson'. According to Pauli's biographer Charles Enz, this lady must be Pauli's grandmother Bertha, who was in fact very musically gifted.[498] Pauli says that he had looked forward to this lesson and tells the lady of his grief and of the girl who also grieved because her mother had destroyed her femininity (Marie-Louise). 'But how can something that has been destroyed excite my feelings?', he asks.[499] This fantasy is very concerned with words and meaning. Words that hurt and redeem, saying the right words, forbidden and censured words, words that distort reality by only presenting a one-sided view of science and religion. It deals with bringing opposites together and reaching a holistic view. The opposites are symbolized by the black and the white keys on the piano. 'One can play in minor on the white keys and in major on the blacks, it is only a question of knowing how to play'. This is obviously an analogy to the *neutral language* that can express psychic as well as physical realities (to which we will return). It also deals with the relation of music to mathematics, and of the musical piece to other forms like, for instance, the inner images (archetypes). In the middle of the fantasy there is a passage called *The Lecture to the Foreign People*. Here Pauli summarizes his views on physics, psychology and biology. After the lecture the lady tells him that he has 'made her a baby' (which shows that the lady is the anima). But the baby has to be legitimate, i. e. one has to produce proof of its existence. The child represents a new holistic attitude that can unite these three subjects. But will it be welcome in science? The fantasy concludes with the 'master's' voice being heard again, saying: 'Wait, transformation of the evolutionary centre' and the lady suddenly has a ring on her finger. This is said to be the *ring i* from mathematics (the imaginary unit $i = \sqrt{-1}$). 'The *i* makes the Void and the One into a pair. At the same time it is the operation of rotation by one quarter of the whole ring', says Pauli. The ring is the symbol of wholeness, it has a uniting function in mathematics and in quantum physics (complex

[498] Enz, *No Time to be Brief*, 470.
[499] Pauli to von Franz, 30 Okt. 1953 [appendix to 1667], *PLC IV/2*.

wave function), and it unites instinct with intellect and spirit in a monistic whole. Rings and rotation had figured earlier in Pauli's dreams.[500] Now the 'transformed' voice of the master says out of the centre of the ring to the lady: 'Stay merciful'. Pauli takes his hat and coat and goes out in the real world. He promises to return.

The reference in this last passage to leaving with his hat and coat is interpreted by von Franz as signifying Pauli's refusing to leave his role as famous physicist, refusing to let go of his 'persona' (in Jungian terms) preferring to desert his anima, his soul, instead. After this Pauli became harsh and brutal towards her, making various impossible demands. Pauli's dreams became shallow and negative and he completely turned away from Jung's psychology and people in his circle.[501] We know that this is far from the truth. Many letters were exchanged between Pauli and Jung after 1953, and there are many letters where Pauli deals with Jung's perspective in a positive way. It is however also true that we find an increasing number of letters from 1955 onwards where Pauli criticizes the 'Jungians', the Jung-Institute and the 'therapy factory'. C.A. Meier judges Marie-Louise von Franz harshly, saying that she totally misunderstood Pauli, failing to appreciate his efforts to conduct an analytic dialogue with her and that their relationship was tragic.[502]

Pauli continued to record his dreams for the rest of his life and this activity increased over the years. Although I cannot go into Pauli's dreams and their symbolism in detail, their most prominent theme was that of rhythm and periodicity. One of the earlier examples of this was his phobia of wasps, which is associated with the fact that the wasp has yellow and black stripes. The stripes are symbols of the 'split' of the contents of the psyche. This phobia goes back to his early childhood (fourth year) and apparently never left him completely.[503] Later Pauli explained to Jung that behind the wasp 'lurked the fear of a sort of ecstatic state in which the contents of the unconscious (autonomous part-systems) might burst forth, contents which, because of their strangeness, would not be capable of being assimilated by the conscious and might thus have a shattering effect on it'.[504] Behind the fear of wasps was the danger of psychosis, but, if transformed, it could open the door to a religious and ethical attitude, as well as an acceptance of what are called parapsychological experiences. 'Stripes' and periodicity recur in the motif of the splitting of spectral lines, the separation of chemical elements (splitting of

[500] Jung, Psychology and Alchemy, *C.W.*12, §258, 301; Pauli to Jung, 31 Mar. 1953 [60], *PJL*.
[501] Interview with Marie-Louise von Franz on 13 March 1993. This interview is preserved on tape.
[502] Interview with C. A Meier, 6 April 1993.
[503] See Pauli to von Franz, 21 August 1953 [1625], footnote 5, *PLC IV/2*.
[504] Pauli to Jung, 28 April 1934 [29P], *PJL*.

isotopes), oscillation, and later – in a more developed form – as rotation and dance. Rotation and dance represent a healed version of the periodicity of the stripes, now connected to the creativity of mathematical thinking (dance = music = harmonies = Pythagorean mathematics) and integration of the anima (soul, meaning, values).[505]

With a bird's-eye view we can follow the development of Pauli's anima problem, as he himself saw it. First it expresses itself in his truly problematic relationships with women. When these improved, after analysis and marriage, the problem shifts to that of nationality, i. e. of roots and belonging. This problem was accentuated during the Second World War, when he was stateless because Switzerland had rejected his request for naturalisation. Due to this his attitude to Switzerland and the ETH became rather resentful. The anima problem now concerned the feminine in the shape of Mother Earth, with which he had extremely bad relations. At first he associated 'her' with nationalism and other kinds of primitive collectivisms, such as communism.[506] He later reassessed his standpoint towards Mother Earth, but in 1952 it was still so bad that he refused to participate in an Eranos conference on the topic *Man and Earth*.[507] Olga Froebe-Kapteyn had arranged these meetings since 1933 at her house on the shore of Lake Maggiore. Jung had been an active participant from the beginning and became their central figure until 1951. The aim was to explore different themes from an interdisciplinary angle. Other lecturers included the Rabbi Leo Baeck, the philosopher Martin Buber, the religious historian Mircea Eliade, and Pauli's friends and colleagues the mathematician Hermann Weyl and the physicist Erwin Schrödinger. Weyl and Schrödinger may have been brought there by Pauli. 'I do not know anyone who is more unsuitable to participate in a conference on this subject than I' Pauli writes, and continues: 'don't see it as a general opposition against your conferences but as a certain opposition towards ›Mother Earth‹'. He claims to have no relation whatsoever with the theme 'Man and earth'.[508] Pauli never lectured at Eranos.

During the Second World War he began to take an interest in the history of science and wanted to explore the attitudes that preceded the breakthrough of classical physics. He absorbed himself in the study of Kepler and Fludd

[505] Pauli to von Franz, 16 August 1953 [1624] + appendix, 21 August 1953 [1625]; 'Modern examples of ›Background physics‹', *PJL*, appendix 3.

[506] Pauli to von Franz, 21 August 1953 [1625], *PLC IV/2*.

[507] Pauli to Olga Froebe-Kapteyn, 23 Dec. 1952, unpublished, *Eranosarchive* (will appear in *PLC suppl.*). See also Pauli to Jaffé, 28 Nov. 1950 [1172], *PLC IV/1*.

[508] Pauli to Olga Froebe-Kapteyn, 23 Dec. 1952, *Eranosarchive*. See also Pauli to Jaffé, 28 Nov. 1950 [1172], *PLC IV/1*.

and in the contrast between the older hermeneutic worldview, which includes a feminine element in the form of Anima Mundi (world soul) who stands in direct relation to the human soul (micro and macrocosm), and the emerging newer one, with its strict demarcation between subject and object, between matter and soul. Here the anima problem is linked to Pauli's view of science and life. It concerns that which we have excluded from our scientific worldview, making it one-sided and hostile to life. His aversion to Mother Earth turns into a feeling of remorse as he suddenly experiences 'her' as a living, maltreated creature (1954). In his dreams the symbols of splitting and sharply contrasting stripes are replaced by rhythmic rotation. Rotation

is of course an attribute of the dynamic Mandala circle (symbol of wholeness), which for Pauli also includes the parameters time and space (as in his vision of the world clock). Rotation becomes dancing and the unknown lady transforms into 'the dark one', a Chinese women who is eventually exalted to the chthonic Sophia: the highest form of earthly and 'underworld' wisdom (the mysteries of life). She stands in opposition to the masculine scientific-rational-logical intellect. This journey can be illustrated by two dreams, one from the beginning of his analysis with Jung and the other from 28 September 1952.

10. Dream:

> *The dreamer is in the Peterhofstatt in Zurich with the doctor, the man with the pointed beard, and the 'doll woman'. The last is an unknown woman who neither speaks nor is spoken to. Question: To which of the three does the woman belong?* [509]

The mandala structure in this early dream is present in the form of the square, enclosed precinct of the church and of the church clock with a strikingly large face (rotation). The man with the pointed beard is the intellect (Mephisto), and the 'doll woman' the anima, who is 'unknown', infantile and objectified (not spoken to). Jung interprets this as an inadequate relationship between the conscious mind and the unconscious.

Twenty years later the dream of 28 September 1952:

> *The dark one is present and this time definitely as 'Chinese'. Her movements are oddly dancelike; she does not speak but only expresses herself in mime, almost as in ballet. She is very beautiful, black-haired, fine-limbed, and with slanting eyes. She walks on ahead and beckons me to follow. She opens a trapdoor and walks down some steps, leaving the door open. I follow her and see that the steps lead into an auditorium, in which 'the strangers' are waiting for me. The Chinese woman indicates that I should get up onto the rostrum and address the people, apparently to deliver a lecture. 'AHA', I think, 'one shall hear upstairs what I lecture downstairs'.*

[509] Jung, *C.W.*12, §136.

> *As I am waiting, she 'dances' rhythmically back up the steps, through the open door into the open air, and then back down again. As she does so, she keeps the index finger of her left hand and her left arm pointing upward, her right arm and the index finger of her right hand pointing downward. When she comes down she points at the rostrum again. 'For her there is no difference between above and below I keep on thinking. The repetition of this rhythmic movement now has a powerful effect, in that gradually it becomes a rotation movement (circulation of the light). The difference between the two floors seems to diminish ›magically‹. As I am actually slowly and thoughtfully mounting the rostrum of the auditorium, I wake up.'*[510]

Here the woman is in the centre, she herself *is* the mandala, as *rotation* she dynamically unites above and below (conscious and unconscious). She is still not speaking but demands that Pauli do so, i. e. that he make a positive effort to unite the disparate parts in his life.

[510] This dream exists in two different versions, one retold to Marie-Louise von Franz, in a letter from 12 Oct. 1952 [1472], *PLC IV/1*; and the other in a letter to Jung, 27 Feb. 1953 [58P], *PJL*. I have here combined the two versions for the sake of completeness.

Pauli, Jung and Science

> Although I am no mathematician, I am interested in the advances of modern physics, which is coming ever closer to the nature of the psyche, as I have seen for a long time. I have often talked about it with Pauli. One is, to be sure, concerned here with aspects of the psyche, which can be mentioned only with the greatest caution, as one is exposed to too many misunderstandings. Probably you will get a taste of them in time. So long as you keep to the physical side of the world, you can say pretty well anything that is more or less provable without incurring the prejudice of being unscientific, but if you touch on the psychological problem the little man, who also goes in for science, gets mad.[511]

Prior to meeting Pauli Jung's interest in natural science expressed itself primarily as criticism of its overconfidence, its narrow-mindedness and its reductionist view of the world.[512] In 1928 Jung cited Einstein's theory of relativity as an example of the way in which for modern man the old absolute explanations were dissolving into the inconceivable. This was tending to force man increasingly to fall back on the reality of the psyche in search of certainty.[513] Jung's knowledge of modern physics prior to meeting Pauli was rather superficial. In 1911 Einstein had indeed been his dinner guest and talked about his 'electrical theory of light'.[514] Jung later states in a letter to Carl Seelig that this conversation caused him to start thinking about the possible relativity of time and space, and the psychic preconditions of these concepts.[515] At all events, Jung's references to science become more numerous

[511] Jung to Pascual Jordan, 10 Nov. 1934, *C.G.Jung Letters,* vol. 1, 176–77.

[512] Idem, 'The Border Zones of Exact Science (November 1896)', *C.W.A*, §42–46.

[513] Idem, 'The Spiritual Problem of Modern Man' (1931), *C.W.*10, §182.

[514] Jung to Carl Seelig, 25 Feb. 1953, *C.G.Jung Letters,* vol. 2, 109; Jung to Freud, 18 Jan. 1911 (230 J), *The Freud-Jung Letters*, 384.

[515] C.A. Meier asserted in an interview which I had with him on 6 April 1993 that Jung had not had any interest in physics at all until he read Meier's contribution to the *Festschrift* for Jung's 50th birthday 'Moderne Physik-Moderne Psychologie', published in the anthology *Die kulturelle Bedeutung der komplexen Psychologie*, ed. Psychologischer Club Zürich (Berlin, 1935). In this he had written: 'If modern physics through its new forms of thinking has discovered a kinship and an affinity with complex psychology, we do not know which of the two disciplines may be the prouder of its new sister. Both sciences have over the course of years of separate work accumulated observations and appropriate systems of thinking. Both sciences have run up against certain boundaries, which we have described at the start of this chapter and which have similar principal characteristics.' (p. 362). That Jung had discussed the relationship between physics and psychology before 1935 is shown by his correspondence with Pauli.

and change character after 1932. He also becomes more explicit, clear and reflective with regard to his own epistemological and scientific positions. Just as Pauli assumed the role of conceptual critic among his fellow-physicists, so he seems also to have worked on and criticized Jung's conceptual apparatus in his discussions with him. As early as February 1932 Jung mentions quantum physics in a letter as an example of the fact that the division between mind and matter is no longer self-evident.[516] In a letter to the physicist Pascual Jordan in 1934 he states that he and Pauli have often discussed how modern physics is drawing closer to psychology and in the passage quoted above he takes the opportunity to add an acid comment on the dilemma of the psychologist as a scientist.

There is no doubt that, even before his contact with Pauli, Jung regarded the psychology he was practising as empirical and experimental (in contrast to philosophical or academic psychology).[517] However his attitude to the term 'science' was ambivalent, because he often identified the term with a causal and reductionist ideal. In so far as he even places science and psychology in opposition to each other, science deals with 'objective reality', whereas psychology deals with 'subjective reality'.[518] Jung contrasts the reductionist method with something he calls the *constructive* or *synthetic* method. He identifies this method with hermeneutics, the ambition to understand man as a whole.[519] As long as the scientific method is identical with a causal explanatory model, psychology, as Jung practises it, cannot be regarded as scientific. The causal method reduces the object of study to its constituents and can only understand things retrospectively. The constructive method, on the other hand, focuses on its prospective and creative aspects. This constructive method of understanding is of necessity speculative and unscientific, but totally indispensable in a discipline that is working with the human psyche.[520] Jung considers that his own 'constructive' method employs a comparative procedure that places different psychic phenomena alongside each other to establish and clarify their mutual relationship and relative strengths. Jung called this approach *energetic* and based it on the results of his experimental work on the word-association test, published in 1904 to 1906 with Franz Riklin. By combining a number of different psychophysical methods of measurement with measurement of reaction time for word associations he

[516] Jung to M. Fuss, 20 Feb. 1932, *C.G. Jung Letters*, vol. 1, 88.
[517] Idem, 'The Psychopathological Significance of the Association Experiment' (1906), *C.W.*2, §863; idem, 'New Paths in Psychology' (1912), *C.W.*7, §407.
[518] Idem, 'On Psychological Understanding', *C.W.*3, §395 ff, §422.
[519] C.G. Jung, 'The Structure of the Unconscious' (1916), *C.W.*7, §494–495.
[520] Idem, 'On Psychological Understanding', *C.W.*3, §397.

was able to confirm the occurrence of emotionally charged complexes. These are described as knots of psychic energy with a core element which may be designated their *affect* or *emotional tone* (*Gefühlston*), and which represents the value quantity or 'value quantum' of the complex. These 'psychological values' form the basic elements with which the psychologist has to work.

Jung developed the basis for his energetic and 'dissociative' view of the psyche before his collaboration with Freud. He maintained this position throughout his cooperation with Freud, a position that differs quite considerably from Freud's view of the genesis of trauma based on infantile stages.[521] We know that Jung opposed the sexual interpretation of the libido

from the very beginning.[522] To distance himself from Freud he began to use the term 'psychic energy' instead of libido, a term that to him seemed more neutral. Jung drew a distinction between the quality of psychic energy and its quantity. Psychic energy *per se* is neutral but can express itself in different qualities or forms (as for instance in different drives). The quality of an affect may, for example, be traced back to a sexual disturbance, but also to other types of disturbances such as, for example, abandonment. The quantitative side of the affect, in other words its intensity or strength, on the other hand, is determined by a comparative method. The word-association test represents such a comparative method, certain signal words arouse stronger associations than others. It is primarily as a result of its higher intensity that the complex may 'disturb' the directed psychic energy of conscious intentions. A purely reductive method can never do justice to the fact that different mental states have different values and strengths; such a method can never explain the experience of feeling torn apart by inner doubt or split between two points of view and the feeling of relief after the resolution of such a conflict. To Jung it is a matter of a clash between *different* psychic needs, which cannot be explained by trying to reduce these obviously different forms of energy to one and the same drive or force.[523] The mental phenomena have to be taken seriously – as genuine statements by and about the mind. It requires one not to reduce mental experience to something else, for example equating a divine experience with a disturbed sexual drive. Here Jung loved to cite William James':

[521] For the influence of the French 'dissociationist' school on Jung see John R. Haule 'From Somnambulism to the Archetypes' in Bishop, ed. (1999), *Jung in Contexts: A Reader* (Routledge, New York), 242.

[522] Jung to Freud, 5 October 1906, *The Freud-Jung Letters*, 4–5.

[523] C.G. Jung, 'On Psychic Energy' (1948), *C.W.*8, §51. Jung postulated a number of different 'instincts' or fundamental strivings in man, of which the sexual instinct is just one. The hunger instinct, the instinct for activity, the drive for reflection and, above all, the creative instinct are other forms of expression of mental energy which are at least as crucial, if not more crucial, to man. Idem, 'Psychological Factors Determining Human Behaviour' (1936), *C.W.*8, §235 ff.

> The reductive method tries to replace the religious and philosophical needs of mankind by their more elementary components, following the principle of 'nothing but', as William James nicely says; but the constructive method accepts them as such and considers them indispensable ingredients of its work.[524]

With the aid of the comparative method, the *typical* components of the mental system are studied, for even the most individual system display similarities and points of comparison with other systems. What may be considered typical depends on the empirical foundation, in other words the volume of case descriptions and comparative material. Even if Jung in 1914 thought that his *comparative* method was not scientific in the classical sense, he nevertheless believed that with time it could form the foundation of a future scientific theory.[525] But it must be remembered that to Jung science was first and foremost a human activity, and, as such, subordinate to psychology. He had already arrived at this view by 1898 and he retained it throughout his life.[526] Science is a tool, *one* function among man's many activities, a limited part of human psychology alongside other equally real functions, such as imagination and feelings.[527] It is based on a capacity for abstraction that is of enormous value in enabling man to grasp and structure existence. But at the same time it also represents a falsification of reality because the actual abstraction involves a rationalization and a simplification of a reality that is fundamentally unknown.

> Science is the art of creating suitable illusions which the fool believes or argues against, but the wise man enjoys their beauty or their ingenuity, without being blind to the fact that they are human veils and curtains concealing the abysmal darkness of the Unknowable. Don't you see that it is life too to paint the world with divine colours? [–––] All things are *as if* they were. *Real* things are *effects* of something unknown. [–––] and moreover there are no real things that are not *relatively real*. We have no idea of absolute reality, because 'reality' is always something 'observed'.[528]

Seen as a human activity, 'science' is subordinate to psychology. In that respect it may be seen as a subject of study for empirical psychology. On the other hand, psychology, to be able to examine this object or phenomenon called 'man's scientific activity', must use a scientific method based on observation and induction. So in psychology science becomes both the object of study and the examining instrument, both subject and object. This, says Jung, is a specific problem of psychology as a science.[529]

[524] Idem, 'On Psychological Understanding', *C.W.*8, §423.
[525] Idem, 'On Psychological Understanding', *C.W.*3, §413, 424.
[526] Idem, 'Thoughts on the Nature and Value of Speculative Inquiry', *C.W.A*, §179 ff.
[527] Idem, 'Psychological Types', *C.W.*6, §76 ff.
[528] Jung to Allen Gilbert, 2 Jan. 1929, *C.G. Jung Letters*, vol. 1 (Ewing, 1973), 57.
[529] Jung, 'Psychological Types', *C.W.*6, §8–11.

An early example of Pauli's influence on Jung's work is a footnote that was included in the 1942 edition of *The Psychology of the Unconscious*. The 1926 edition says that in theory it is simply impossible to imagine processes that are not causal, while one always stumbles on them in everyday life.[530] In his own copy of the book Pauli has marked this passage and written 'oho!' in the margin.[531] Quantum physics had been working with non-causal processes since 1900. The 1942 edition contains the following footnote added by Jung:

> Modern physics has put an end to this strict causality. Now there is only 'statistical probability'. As far back as 1916, I had pointed out the limitations of the causal view in psychology, for which I was heavily censured at the time.[532]

It was of course primarily Pauli who gave Jung a direct insight into the worldview of modern physics and who by discussing the subject helped to expand Jung's epistemological awareness. In all probability these discussions are also the source of certain changes in Jung's conceptual apparatus and terminology. Pauli's influence is particularly evident in Jung's 1946 essay 'On the Nature of the Psyche', in the work on synchronicity (1952), in *Mysterium Coniunctionis* (1955–56), and in the late essay 'The Undiscovered Self (Present and Future)' (1957).[533] Jung underlines repeatedly in later writings that he is an empiricist and a scientist. There is much to indicate that this increasing confidence with regard to his own viewpoint derived from his contact with Pauli. Another interesting example is that after 1932 Jung gives his method the name *phenomenology*.[534] In 1934 Pauli sent Jung a copy of Pascual Jordan's essay 'Positivistische Bemerkungen über die Parapsychischen Erscheinungen' (Positivistic remarks on Parapsychology) to hear what he thought of it. In the accompanying letter Pauli concluded that what Pascual Jordan here described as *radical positivism* – i. e. the idea that man's inner experiences should be accorded the same empirical rank as the sensory impressions – could just as well be called a *phenomenological* viewpoint.[535]

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[530] C.G. Jung, *Das Unbewusste im normalen und kranken Seelenleben* (Zürich, 1926), 104.

[531] The book is in 'La Salle Pauli', CERN, Bellettrarisches No. 99.

[532] C.G. Jung, 'The Psychology of the Unconscious' (1942), *C.W.*7, §72, note 4.

[533] Idem, 'Der Geist der Psychologie', *Eranos-Jahrbuch 1946* (Zürich, 1947); idem, 'Synchronizität als ein Prinzip akausaler Zusammenhänge', *Naturerklärung und Psyche* (Zürich, 1952). (Cf 'Synchronicity: An Acausal Connecting Principle', *C.W.*8), 'Mysterium Coniunctionis' (1955–56), *C.W.*14, 'Gegenwart und Zukunft' (1957), *C.W.*10, §488 ff.

[534] C.A Meier believes that it is likely to have been Toni Wolff, Jung's close colleague since 1910, who introduced the term 'phenomenological method' with regard to the working methods of analytical psychology. Her contribution to the miscellany *Festschrift* on Jung's 50th birthday, 'Die kulturelle Bedeutung der komplexen Psychologie', strongly confirms this impression. But Pauli, too, undoubtedly had a reinforcing effect on Jung's adoption of this terminology.

[535] P. Jordan, 'Positivistische Bemerkungen über die Parapsychischen Erscheinungen'. See Pauli to Jung, 26 Oct. 1934 [7P], *PJL*, 6.

> Do not be put off by the word 'positivistic'; it is unlikely that J's ideas have anything to do with any philosophical system, and I would suggest that he replace the word 'positivist' with 'phenomenological'.[536]

The other interesting thing about this statement is that Pauli at this point in time sees positivism as a philosophical system, whereas he identifies phenomenology with a methodological approach.[537] This suggests the direct influence of Ernst Mach, who labelled his own method phenomenological. The view that psychic experiences are also to be regarded as phenomena in their own right is a position which Pauli must have recognized from Ernst Mach's 'psychophysically neutral' perception of reality, which does not distinguish between consciousness and its objects. To Pauli, Jung's phenomenological position was not difficult to accept. As Pauli saw it, the scientist lives naturally between two phenomenological worlds: the world of empirical phenomena, which inspire certain reflections, and the world of ideas and conceptions, which also manifest themselves as spontaneous phenomena and which then have to be modified when confronted with observed facts.[538] The first time the term phenomenology occurs in Jung's writings is in 1937 when he describes his psychological method.[539] But as early as 1935 Toni Wolff refers to the method of complex psychology as phenomenological, although she is eager to distinguish it from the philosophical school of phenomenology (Hegel, Husserl).[540] The so-called phenomenological viewpoint does not involve a new line of attack – only the label is new – it is in fact the same attitude that Jung earlier called constructive and comparative, i. e. the opposite of reductionism.[541] It coincides with the starting point described earlier: taking psychic phenomena seriously, seeing them as 'psychic facts or realities', giving them a value of their own and not trying to reduce them to anything else, such as physiological processes, or to fit them into a fixed theoretical model. Here we recognize the way in which Pauli used the term *phenomenological viewpoint* back in 1923 to describe his critical attitude to concepts and models in physics that have no counterpoint in actual observations.[542] Pauli had taken this viewpoint from Ernst Mach, and now he recognized Mach's viewpoint in Jung.

[536] Ibid.

[537] See also pages 76 ff and 85 ff in this work.

[538] Pauli, 'Science and Western Thought', 138–39.

[539] C.G. Jung, 'The Terry Lectures' (1937), *C.W.*11, §2.

[540] Complex psychology was an early term for Jung's analytical psychology.

[541] Wolff, 42. When for example the essay 'Zur Psychologie des Geistes', *Eranos Jahrbuch* 1945 (Zürich, 1946), was republished in 1948, the title had been changed to 'Zur Phänomenologie des Geistes im Märchen'. Cf *C.W.*9*I*, §384 ff.

[542] Pauli to Landé, 23 May 1923 [35], *PLC I*, 87; Pauli to Eddington, 20 Sep. 1923 [45], ibid., 118.

Pauli's attitude to Jung's theories is not a simple one. In some letters he speaks very critically of Jung's terminology and calls Jung's mind 'quite without scientific training'.[543] In a long letter to Bohr in 1955, for example, we find the following opinion:

> I only refer here historically a situation without identifying myself with this kind of terminologies, which seems to me rather far from logical clarity. The Jung-school is more broad minded than Freud has been but correspondingly also less clear. Most unsatisfactory seems to me the emotional and vague use of the concept 'Psyche' by Jung, which is not even logically selfconsistent.[544]

At first sight Pauli seems here to be dissociating himself from Jung's theories and terminology. He charges Jung with illogical use of language and thus, basically, with not being scientific. But this does not accord at all well with the categorization of Jung's theories that he had published a few months earlier in the journal *Dialectica*: 'Jung employs a psychological-scientific terminology instead of the philosophical-metaphysical'.[545] When one recalls Pauli's extreme caution in publishing anything of which he did not feel absolutely certain, these contradictory statements at first seem mysterious. There is of course no doubt that Pauli had accepted the greater part of Jung's perspective and he uses Jungian terminology consistently in his letters. But at the same time it is also evident that Pauli is critical of some of Jung's concepts, and the use of the term 'psyche' is definitely one of them. Most probably Pauli was also anxious to guard against being regarded as a 'believing Jungian'. Pauli writes to his fellow-physicist Abraham Pais:

> Nevertheless I consider the idea of the collective unconscious in general and the interpretation of the mandala as *psychic centration processes* in particular as generally right. Naturally not because the great C.G. Jung has said so (I am not a woman and obedience to authority was not sung to me in the cradle), *but because* the thing seems to me essentially plausible.[546]

Pauli cannot simply be classed as a 'disciple' of Jung. He is far too critical for that. He does not wait long before venturing to criticize Jung's interpretation of his dreams:

> By way of my contribution to the parallels mentioned, I would like to mention just one point where I had the feeling that your dream interpretation was not entirely accurate. (As you can see, I still won't be 'fobbed off' with just anything.)[547]

[543] Pauli to Fierz, 20 Mar. 1950 [1091], *PLC IV/1*.
[544] Pauli to Bohr, 15 Feb. 1955 [2015], *PLC IV/3*.
[545] Wolfgang Pauli, 'Ideas of the Unconscious from the Standpoint of Natural Science and Epistemology' (1954), *Writings on Physics and Philosophy*, 163.
[546] Pauli to Pais, 17 Aug. 1950 [1147], *PLC IV/1*.
[547] Pauli to Jung, 28 Feb. 1936 [16P], *PJL*, 15.

Pauli's main critique concerned 'the Midas effect' of Jung's psychology i. e. the tendency to turn every phenomenon into something 'psychic': for instance to regard physical principles as projections of psychic mechanisms onto matter. Another important issue was the nature of the relationship between conscious and unconscious. Should they be regarded as mutually exclusive and complementary units, or should consciousness be regarded as a borderline area adjoining the unconscious? Pauli preferred the first alternative. A big concern to Pauli was Jung's tendency to ascribe to the unconscious a sort of consciousness of its own and an almost deterministic developmental 'program' that runs its course irrespective of consciousness. Pauli wanted to put much more emphasis on the role of consciousness (see below). He furthermore criticizes Jung's definition of the psyche as a 'conscious-unconscious whole' while at the same time stating that the psyche and its content is the only reality *immediately given* to us.[548] Pauli points out that these two statements are logically incompatible. Both the unconscious and its structuring principles (archetypes) lie beyond the directly observable, and cannot therefore be considered as 'immediately given'. A clear distinction must be made between the psychic experiences of the individual and the concepts that one uses to explain these experiences.[549] The 'conscious-unconscious whole' must be something that reaches far beyond the psyche into the unknown and should therefore not be designated with the term 'psyche'. Jung's concept of the psyche was at great risk of becoming 'overloaded' and expanding beyond its proper limits, ending up as a pure tautology.[550] An example of this is Jung's way of using the term 'psychic statement', discussed by Pauli in 1955.

What was interesting and unique about Pauli was the fact that he was genuinely interested in Jung's psychology without swallowing it whole. This is relatively unusual: most of those with an academic or scientific background dismiss Jung totally, whereas among those who accept him there is more often than not an uncritical 'sectarian' tone. What many Jungians describe as Pauli's cowardice in the position he took with regard to Jung's theories seems to me rather to be a critical stance which characterized not only his attitude to Jung's psychology but to an equal degree his attitude to physical theories. Not that I entirely dismiss the idea that Pauli was afraid to stand up in public for Jung's theories, a fear which undoubtedly had seeds in the fact that he was jealous of his scientific reputation, but which also – I believe – reflected an inner conflict between different points of view.

[548] Jung, 'On the Nature of the Psyche', *C.W.*8, §397.
[549] Pauli to Fierz, 7 Jan. 1948 [929], *PLC III*, 496.
[550] Pauli to Jung, 31 Mar. 1953 [60P], *PJL*,104.

This becomes particularly apparent when one sees how differently Pauli expresses himself when talking to different people. For example we may compare what Pauli writes to Jaffé concerning Jung's use of the concept of *psyche* with the statement to Bohr quoted above. Here, too, he is critical of how Jung uses the concept, but he puts his conceptual criticism in a wider epistemological and psychological context. He makes the general epistemological point that most thinkers, and especially those who are anxious to be *anti-metaphysical*, often display a compensatory faith in a single principle and tend to elevate this explanatory principle at the expense of all else. Ernst Mach, whom Pauli mentions as an example, considered himself an ardent empiricist of strongly anti-metaphysical convictions. But on closer inspection he is found to have a compensatory belief that 'reality is a continuum', a belief which led him to oppose fanatically the atomic theory with its discrete particles. In the same way Pauli believed that the concept of the 'psyche' filled the role of an emotionally charged metaphysical basic assumption on Jung's part.

> This emotional content or this (unconscious) precondition of *mood* now seems to me *roughly* expressible in the words 'everything is psychic', or 'the psychic is the highest', or 'the psyche must be everywhere'.[551]

Just like Mach, Jung tries to restrict himself to a description of *phenomena* and asserts energetically that he is an empiricist and does not construct speculative systems. This is made up for by the elevation of one principle – namely 'the psychic' in Jung's case. However, Pauli finds this dynamism between an empirical or realistic standpoint and a metaphysical conviction in many others, including Einstein. Pauli is at pains to point out that this 'metaphysical' side of Jung is only a question of emphasis that emerges in certain situations. It is a nuance that becomes apparent when Jung is under pressure in discussion with Pauli, who comes from physics, a discipline that is guided by other metaphysical preferences. In all essentials however, they agree.[552] In other places Pauli was not nearly so subtle in his criticism of Jung, as we see in the letter to Bohr. This letter also indicates that he never discussed his deeper interest in Jung's psychology openly with Bohr, as he mentions psychology and philosophy only in very general terms. The reason for this might have been that he did not see Bohr as interested in or receptive to the type of discussion he was looking for.

It is apparent from Pauli's correspondence that he actually sought among his physics colleagues partners with whom he could discuss the perspectives that he had acquired from Jung's psychology. If he had been extremely worried

[551] Pauli to Jaffé, ca 10/11 April 1953[1551],*PLC IV/2.* .
[552] Ibid.

about his reputation (as some claim) he would scarcely have brought up the subject with people like Herman Weyl, Friedrich von Weizsäcker, Abraham Pais and Max Delbrück.[553] What Pauli lacked above all were people who were familiar with Jung's analytical psychology *and* with theoretical physics, with whom he could discuss both subjects in a critical manner. Such people were hard to find and this caused a certain despondency in Pauli, who lamented the fact repeatedly in his letters.[554] Markus Fierz could to some extent fill the gap because he both had an insight into Jung's psychology (his twin brother was an analytical psychologist!) and was also a theoretical physicist. Pauli therefore dubbed him his *psychophysical partner*.[555] The conversations and correspondence with Markus Fierz play a very important part in the development and deepening of Pauli's interest in the relationship between quantum physics, philosophy and depth psychology. Their letters are less personal and deal generally with more philosophical than psychological subjects. As time went by Pauli became increasingly irritated by the 'Jungians' ' lack of scientific training. To von Franz he wrote:

> In general I am now rather tired of the lack of mathematical-scientific training of Jung's whole circle. I still always hope for the miracle of some day finding someone who is both adequately trained in mathematics and science (about to the level of a second term student) and also has the necessary human maturity to understand the psychological side of my dreams.[556]

We have been able here to see that Pauli felt a greater need to discuss and question than to lay down opinions in publications. In this respect Pauli approached Jung's psychology in the same way as he did theoretical physics. To Pauli it was important to be aware of the problems and he identified with the heretic who professes no allegiance to any church. In an essay written to mark Jung's eightieth birthday there is no trace of humble deference. Pauli's way of paying tribute to Jung is rather to show how far Jung's perspective is a productive one and which fundamental problems and shortcomings remain to be tackled.[557]

> . . . what I am *now* doing, namely writing the article for 'Dialectika' [N.B. I have altered the title slightly to 'Scientific and epistemological aspects of the idea of the

[553] Pauli to Fierz, 21 Jun. 1949 [1035], *PLC III*, 669; Pauli to Weizsäcker, 5 May 1953 [1568],*PLC IV/2*; Pauli to Pais, 17 Aug. 1950 [1147], *PLC IV/1*; Pauli to Delbrück, 6 Oct. 1958 [3075], *PLC V/4*. In 1958 Pauli even ventures into interpreting Delbrück's dreams!

[554] See for example Pauli to von Franz, 15 May 1953 [1572], *PLC IV/2*.; Pauli to Jung, 27 May 1953 [62P], *PJL*, 123.

[555] Pauli to Fierz, 5 Dec. 1948 [989], *PLC III*, 583. Markus Fierz had a twin brother named Heinrich Fierz, who was a trained analytical psychologist and head of the psychiatric clinic at Zürichberg.

[556] Pauli to von Franz, 15 May 1953 [1572], *PLC IV/2*.

[557] Pauli, 'Ideas of the Unconscious', *WPP*, 150 f.

> unconscious' – What do you think?]. I have therefore taken the word 'psychology' out of the title so as not to create the appearance of speaking as a psychologist myself. It will be a great heresy, the article – seen from *any* angle. I feel rather like a horse, that lashes out in *all* directions 'a pioneer of freedom, but not a pioneer of the government', as Shaw once described such a horse.[558]

An early and distinctive feature of Pauli's attitude to Jung's psychology is that he finds in it a really fruitful approach that contains the possibility of a future scientific psychology. Pauli stipulated two criteria of a scientific theory: it had to be testable and communicable. A theory has to possess what Bohr had defined as communicability: the possibility of being unambiguously communicated and taught to others – i. e. forming the basis of a school of research. By testability Pauli did not mean that each individual statement in a theory should be testable, but that the intellectual structure as a whole must be capable of empirical testing.[559] Pauli considered that Jung's psychological model fulfilled these requirements, despite certain inadequacies in the conceptual apparatus and insufficiently systematic follow-up of certain arguments. The critique of Jung's lack of scientific training concerned his shortcomings regarding the methods of natural science, such as mathematical thinking, a weakness that Jung himself also admitted. The conceptual apparatus was, according to Pauli, the weakest point in Jung's model. In his conversations with Jung, therefore, Pauli laid great emphasis on the clarification of some of the most fundamental concepts. In this way he took on the same role as the one he exercised among his fellow-physicists.

Pauli felt that Jung's theory was of great provisional value, containing the beginnings and possibilities that were required for a truly scientific approach. In a letter to his colleague Ralf Kronig in 1934 Pauli writes of his crisis and his encounter with the autonomous phenomena and processes of the psyche.[560]

> . . . I also made the acquaintance of psychic things, which I did not know before and which I would summarize under the name *autonomous activity of the soul*. That there are things here, spontaneous growth products [. . .] that can be designated symbols, something objective-psychic, which cannot and may not be explained as resulting from material causes, is to me beyond doubt. I am certain that one day it will all be scientific psychology (but truly scientific, not one which reduces everything to material causes or 'drives').[561]

[558] Pauli to von Franz, 17 Feb. 1955 [2019], *PLC IV/3*.

[559] Pauli, 'Science and Western Thought', *WPP*, 138–39.

[560] This is, incidentally, the first surviving letter in which Pauli speaks of his interest in Jung's psychology to a fellow-physicist (even if Jung's name is not mentioned).

[561] Pauli to Kronig, 3 Aug. 1934 [380], *PLC II*, 340–41.

Pauli's view of science and the humanities emerges clearly in a letter to the cultural historian Erich von Kahler. Here Pauli gives his view on whether *history*, as Kahler defines it, may be considered a science. To Kahler history cannot be seen merely as a series of external events that follow each other in sequence, because the concept of history assumes some kind of coherent pattern. A chaotic quantity of facts is not history. In his reply Pauli lists the criteria which he thinks history needs to satisfy before it can be treated as a science.

1. The basic requirement is the epistemological realization that we can never know anything about 'history in itself' (Kant), because there is no ontological or logical proof of the existence of history.
2. *Empirical* proof of history could be obtained in two ways. One would be if it were possible to lay down *natural laws* concerning the historical course of events based on scientific facts about man. This presupposes a *theoretical psychology* from which these natural laws could be deduced, a psychology that encompasses both the individual and the collective. The other would be an inductive approach, in which the phenomenological method was used to draw conclusions based on the history that has so far unfolded. Such a method must however demonstrate its serviceability by, at least in broad outline, being able to offer predictions about the historical course of events.
3. As long as such empirical proof does not exist, historiography consists of images based on the desires and fears of various epochs – images that have sprung from a specific external situation in combination with a specific *mentality*. This mentality is in turn influenced by *unconscious* factors; something which must not be overlooked when one tries to understand human patterns of behaviour.[562] It is clear that Pauli embraced the third position, as there do not as yet exist such empirical proofs concerning history and man.

It was the phenomenological, non-reductionist viewpoint of Jung, combined with his attempts to formulate a theory of the specific regularities of the psyche (the archetype theory) that led Pauli to regard his psychology as scientific. Pauli hoped that in the future it would be possible to integrate Jung's psychology with the rest of science. A great deal of Pauli's interest in Jung is focused on this question. In his opinion the importance of Jung's psychology

[562] Pauli to von Kahler, 30 Dec. 1949 [1070], *PLC III*, 731.

extended far beyond the therapeutic activity.[563] Its main significance lay in its contribution to science:

> This way of looking at things leads me to expect that the further development of the ideas of the unconscious will not take place within the narrow framework of their therapeutic applications, but will be determined by their assimilation to the main stream of natural science as applied to vital phenomena.[564]

It is on the strength of such statements that Pauli has been accused of wanting to turn Jung's psychology into a philosophy in order to avoid confrontation with his own personal problems.[565] But Pauli argued that there is no contradiction between working with a new scientific attitude and coping with personal problems. In fact he considered these two areas to be tightly knit together: man's inner subjective situation is reflected in his culture, religion, worldview and science. Pauli did not deny the importance of working with the subjective factor, but believed that Jung's psychology also contains elements which can shed new light on how psyche and matter are related to each other.[566] In addition it seems that Jung agreed with Pauli that the actual psychotherapy was not the main strand in his thinking. The really essential side lay in the construction of an integrated and holistic conception of nature and of man's position in it.[567]

When Jung agreed to start an institute in his name, his prime intention seems to have been to establish a centre for education and research in the subjects that are of great importance to analytical psychology. Alongside purely clinical research with association methods and case descriptions, Jung attached great importance to the interdisciplinary exchange with, in particular, humanist subjects, such as history, religion, mythology and sagas, philology and others.[568] Pauli wanted to support such a project and consented to be one of the founders of the institute. However he cherished the hope that this line of research would also draw closer to collaboration with natural science.[569]

[563] 'I also represent the proposition that the future of the psychology of C.G. Jung does not lie at all in therapy and the therapist, but leads to natural philosophy, or at any rate to the philosophical faculty.' Pauli to von Franz, 18 Apr. 1951, [1227] *PLC IV/1*.

[564] Pauli, 'Ideas of the Unconscious', 164.

[565] Herbert van Erkelens, 'Wolfgang Pauli's Dialogue with the Spirit of Matter', *Psychological Perspectives* 24 (1991), 44.

[566] 'This subjective side *also* exists and concerns [...] that my relationship to psychology may not become intellectual and must remain a relationship via the unconscious: the ›correspondentia‹ must always at the same time express a piece of the *de facto* existing process of individuation.' Pauli to von Franz, 6 May 1953 [1569], *PLC IV/2*.

[567] Pauli to Fierz, 25 Dec. 1950 [1188], *PLC IV/1*.

[568] C.G. Jung, 'Address on the Occasion of the Founding of the C.G. Jung Institute, Zürich, 24 April 1948', *C.W.*18, §1129 ff, and 'Foreword to the First Volume of Studies from the C.G. Jung Institute', ibid., §1163.

[569] Pauli to Jung, 23 Dec. 1947 [33P], *PJL*.

Pauli therefore saw himself as the scientific sponsor of the Jung Institute and with time became increasingly troubled when he saw that the Institute was not following Jung's original aims. In the summer of 1956 he wrote three angry letters to the trustees of the Institute, in which he called for its activities to be subjected to stricter scientific requirements. He felt that the Institute was threatening to damage and nullify Jung's efforts to bring his psychology in as a branch of science.

> In this connection, I should like to point out that psychology always used to be counted as one of the *humanistic* sciences, but it was precisely C.G. Jung himself who emphasized the scientific nature of his ideas, and it was through his works that the way was paved for an integration of the psychology of the unconscious into the natural sciences. It is my opinion that the progress that has been made in this respect is being *seriously jeopardized by the administration of the C.G. Jung Institute*.[570]

Among other things he wanted the lecturers at the Institute to demonstrate their competence by ensuring that their students produced original empirical or theoretical work. At the same time he criticized the psychotherapeutic practice, which was beginning increasingly to resemble profitable big business with assembly-line analyses. Instead of a genuine interest in research into dreams and myths, all activity was concentrated on individual analysis. Dreams were of interest only to the extent that they arose in the individual analytical situation. The dreams of 'normal' people, in other words people who were not receiving Jungian analysis, were of no interest. From a scientific point of view this had to be regarded as a cardinal error. Only by research into the emotional life of the normal individual – people who are not undergoing therapy or analysis – can we obtain a comparative material alongside which the psychological process of the neurotic or help-seeking individual may be placed.[571]

Pauli was shocked at the assertion of the then president and his good friend, C.A. Meier, that it would be impossible to examine the dreams of people who are not receiving analysis. Pauli even thought that people ought to be trained for just this purpose, people who are not doctors or therapists. The latter were entirely preoccupied with giving profitable analyses, while the statutes of the Institute concerning research and production of scientific work had been pushed far into the background. The analyst occupied a monopolistic position as far as the study of unconscious processes was concerned and strove to surround himself or herself with as many patients as possible.

[570] Pauli to the Curatorium of the C.G. Jung-Institute, 22 Jul. 1956 [Appendix 9, 1], *PJL*, 212.
[571] Ibid., 213.

At the same time he/she was continually casting jealous sidelong glances at all colleagues. This could only lead to one thing: *mental incest*.[572] Pauli demanded immediate proposals for action and called for an official reply to his letter. His letters undoubtedly managed to cause something of a stir, and C.A. Meier resigned from the presidency. However no major changes resulted and Pauli did not feel that he received the support of anyone inside the C.G. Jung Institute. To Pauli the formula *analytical psychology* $\neq$ *the C.G. Jung Institute* applied. He wanted to relinquish his post as scientific patron of the Institute but wished to wait until after Jung's death so as not to hurt him. But Pauli died before Jung.[573]

[572] Pauli to the Curatorium of the C.G. Jung-Institute, 6 Aug. 1956 [Appendix 9, 2], *PJL*.
[573] Pauli to Jaffé, 18 Mar. 1957 [2581], *PLC IV/4i*.

Complementarity, Symmetry and the Cosmic Order

> 'On the other hand there is still much mysterious in the relation of ›inner‹ and ›outer‹. One will only find out about it if one stays nicely with one's nose complementarily in the middle…'[574]

Pauli only gradually assimilated Jung's conceptual apparatus and worldview. After a cautious start during and immediately after his analysis in 1932–1934 it seems that his interest in Jung's terminology and perspective markedly intensifies after the Second World War. We will now try to follow the development of Pauli's attitude to Jung's ideas from a chronological perspective, while making necessary deviations for the sake of clarity.

The first general discussion in the correspondence appears as early as 1934 and concerns Pascual Jordan's essay *Positivistische Bemerkungen über die Parapsychischen Erscheinungen* (Positivistic remarks on Parapsychology).[575] The issue was whether the conscious and the unconscious should be regarded as complementary units, i. e. as mutually exclusive, or whether one should regard consciousness as a narrow borderline area adjoining the unconscious. The question naturally arose because Pauli wanted to understand the relationship between consciousness and the unconscious in terms of the complementarity principle. Jung, who did not have the same perspective as Pauli, replied that the border between consciousness and the unconscious is fluid: the unconscious forms a layer of the psyche where the individual distinctions of consciousness are more or less extinguished.[576]

Here we have an excellent example of the above-mentioned interplay of different intellectual temperaments and what it meant to the development and deepening of the two men's views of the world. We return here to the distinction between a system thinker and a problem thinker described above. To Pauli concepts form logical units that must stand in a well-defined relationship to each other. In the case of the relationship between consciousness and the unconscious, either they must be mutually exclusive, or the one must

[574] Pauli to Fierz, 2 Mar. 1948 [940], *PLC III*.
[575] Jordan, 'Positivistische Bemerkungen'; Pauli to Jung, 26 Oct. 1934 [7P], *PJL*.
[576] Jung to Pauli, 29 Oct. 1934 [8J], ibid.

be a part of the other. The latter idea appealed less to him. To Jung the concepts always came second. Jung tries to describe something he has observed and fumbles for words. He works with many different images in order to approach a rather inaccessible area of experience. He therefore presents a sliding picture: the conscious and the unconscious form part of the same psychic sphere but consciousness with its distinguishing characteristics is obliterated slowly as it passes over into an unconscious state. After that it is *more or less* extinguished.

On a number of occasions we can observe how Pauli's conceptual thinking comes into conflict with Jung's more imprecise and intuitive thinking. What is interesting, however, is that these differences in perspective gave rise to discussions that were rewarding on both sides. Pauli is constantly broadening his perspective and Jung is obliged to sharpen his conceptual apparatus. Pauli's interest in the psychology of Jung was to a great degree epistemological. Inspired by Bohr's philosophy of complementarity Pauli wished to go deeper into the process of cognition with the help of Jung's perspective. He was particularly interested in the relationship between subject and object and between sensory impressions and conceptualization (also expressed in the relation between theory and experiment). His starting point was the complementarity perspective: conscious and unconscious may be seen as two mutually exclusive concepts and psychology and physics may be seen as two complementary methods of looking at existence.

The position adopted by Pauli, which follows him throughout his life, may be summarized in the words: *keeping in the middle*. This tendency recurs on many different levels in Pauli's life. On a *personal psychological* level it implies the ability to pay heed to the products of the unconscious. The unconscious stands in a compensatory and complementary relationship to consciousness and in order to live a balanced life both sides have to be considered. As far as Pauli was concerned this involved 'allowing the unconscious to come to expression', in other words first and foremost very carefully observing dreams and fantasy material, writing them down, drawing them and also engaging in dialogue with his inner figures.[577] The driving force behind this observance of 'the opposite side' was a longing for balance, symmetry and harmony, also a central theme of Pauli's visions and dreams.

The search for symmetry was also revealed in Pauli's *scientific work*. Both the exclusion principle (1924) and the neutrino hypothesis (1930) were based

[577] 'enable the unconscious to have its say' (das Unbewußte zum Wort kommen zu lassen), Pauli to Jung, 27 Feb. 1953 [58], *PJB*, 86. Cf. *PJL*, 84. The method of holding a dialogue with the unconscious was developed by Jung under the name of 'active imagination.'

on Pauli's belief in the symmetrical properties of matter. Even his initial refusal to accept the breach of mirror symmetry (i. e. the parity violation, Yang and Lee, 1956) – the fact that the parity principle is not preserved during weak interaction – was due to his firm belief in the symmetry of nature.[578] Pauli's belief in a non-visualizable underlying order in the cosmos, which cannot be captured in our rational concepts or categories, is the *religious* expression of the same search for the 'middle'. This attitude seeks the reconciliation of the opposites in a 'higher' principle. Here Pauli saw the Taoist position as ideal, *Tao* is an intermediate position because it does not take sides between the opposing pairs but realizes that good and evil, spirit and matter, psyche and physis are different aspects of the same underlying 'third' reality. To Marie-Louise von Franz Pauli writes that although he feels a hundred percent Western, he has been fascinated by China and the Chinese on account of the symmetrical approach which has formed the foundation of their culture and their civilization for thousands of years. Such a symmetrical position is uncommon in Western history, but Pauli now sees signs of an emerging symmetry in the thinking of, in particular, Bohr and Jung.

> It is clear to me what I find fascinating about China: it is the exactly *symmetrical* attitude to the opposing pair Yin (female, chthonic, dark = *Moon*) and Yang (male, spiritual, light = *Sun*). On this is based a thousand-year-old culture and civilization, which is constructed steadily and constantly. It is the '*the middle Kingdom*' – and it is of awe-inspiring age [–––].
>
> The same *symmetrical* conception or position *also* fascinates me if I encounter it in the West. Admittedly it is relatively seldom found here. In old Hellas a relatively short epoch seems to have been 'symmetrical' to Apollo and Dionysius, particularly the Pythagoreans; then I found an 'archaic' symmetry in *Fludd* (also in the 'kabbala') and – last but not least – one pointing to the future, both in Bohr and in Prof. Jung.[579]

The same search for the 'the kingdom of the middle' crops up again in Pauli's discussion with Jung on whether or not the archetypes are to be regarded as psychic entities. In his effort to steer a middle course Pauli does not want

[578] 'The deeper physical meaning of the exclusion principle lay however in the fact that it introduced a new non-dynamical force in physics which depended on a symmetry property of matter' and 'A little later, when Pauli had changed his attitude to the hole theory, he wrote to Heisenberg: ›If it be true that the laws of nature are completely symmetrical in relation to positive and negative electricity (and all observable differences can be attributed to the ORIGINAL STATE of our environment) – if therefore a negative proton should exist – then the free neutron should… be able to exist in TWO states.‹ With this Pauli professed once again his belief in the general symmetry of matter and antimatter which was based now however on the theory of Dirac'. Meyenn, 'Pauli's Belief in Exact Symmetries', 340, 348, 351 ff. It is also interesting that the discovery of the neutrino at the same time foreshadowed a breach of symmetry, namely the loss of parity which Yang and Lee discovered in 1956. See Enz, 'A Biographical Introduction', 19.

[579] Pauli to von Franz, 12 Nov. 1953 [1672], *PLC IV/2*.

to see the archetypes as 'psychic' structures which are projected onto material objects, but as factors which belong to the third order which structures *both* psyche *and* matter. In the same way he wants to regard psychology and physics as complementary forms of knowledge, which together form a more comprehensive picture of a unified reality. He does not want to see physics only as 'materially labelled conceptions' – i. e. conceptions concerning matter – as Jung expressed it from his purely psychological perspective. Pauli even writes that from this point of view he sees himself as more of a 'Platonist' than Jung. Whatever it is that shapes and structures our world must belong to an abstract, 'neutral' sphere, a cosmic order which is perhaps most reminiscent of Plato's *Eidola*. These appear of course to be both something of a concept *and* a force of nature because they are described as living and acting forces that produce 'effects' in the world of our perceptions.[580] A few years later he accuses Jung of platonic idealism precisely because of his 'reduction' of the archetypes to purely psychological factors. Behind this contradiction lie two different ways of defining Plato's thinking. In the first case he refers to Plato's *eidola*, which can be characterized both as conceptual but also as 'natural forces' acting on reality. In this sense they are beyond mind and matter and manifest themselves in both. This kind of metaphysical order was acceptable to Pauli. The second way of defining 'Platonism' focuses on the one-sided 'mentalist' worldview of the Platonists and their definition of matter as a 'lack' (*privatio*) of existence. Jung's definition of the archetypes as psychic contents that are projected onto the outer world betrayed such one-sidedness. The factors creating order in mind as well as matter might very well be called 'archetypes', provided that they are *not* defined as psychic contents. They must be seen as lying beyond psyche and matter but manifesting in both areas. On the psychological level they take the form of archetypal imagery and symbols. On the physical level, on the other hand, they manifest *as laws of nature*. This position of Pauli's persuaded Jung to widen his concept of the archetype in an even more non-visual, non-platonic direction.

Pauli's preferences were decidedly non-platonic. In contrast to Plato, Pauli was looking for the link between sensory impressions and concepts. This question hardly interested Plato, who considered sensory experience of no crucial importance to human knowledge. Real knowledge is based solely on reason. This repeated emphasis on reason, which is in addition identified with Absolute Goodness, Beauty and Truth, is not exactly an attitude that 'stays in the middle'. To Pauli this theme was to become very important. Writing

[580] Markus Fierz, 'Zur Physikalischen Erkenntniss' (1949), *Naturwissenschaft und Geschichte*, 21; Pauli to Fierz, 7 Jan. 1948 [929], *PLC III*, 496.

to his friend Hecke in 1938, Pauli explains that he has been particularly attracted to Jung's theory of the collective unconscious because it has put wind in his 'anti-spiritual sails'. He was as sceptical of a purely idealistic view as of a purely materialistic one. It was for this reason that he also liked Schopenhauer, who of course describes the *will* as a sort of natural instinct. If there is a driving force, an *agency*, which is active in the world, through history and in man, then it must not be called 'spirit'. Certainly not, if spirit is conceived as something over which man has conscious control (through reason) and which he can deal with as he pleases. This latter-day Western conception is in stark contrast with more primordial conceptions of the spirit as something that 'befalls' man as an irrational force.[581]

Pauli assumed that this *agency* must have some connection with the type of natural intelligence that lies behind the navigational powers of migrating birds and eels. It is most probable that this function is independent of time and space and that what we call 'spirit' may be a later, more developed version of it. He wishes to see this 'guiding principle' in an evolutionary light, as a part of nature that can manifest itself on different levels of existence. Similarly he wishes to see logical thinking as something that has evolved out of archetypal thinking, which is basically irrational. The archetypes underlie our conceptions and express themselves primarily in the beholding of fascinating internal images. Logical thinking, on the other hand, is aimed at clearly formulated ideas. On this basis, Pauli conceives of Plato's *eidola* as something between archetype and elaborate idea, as a kind of 'model' that guides the shaping of ideas.[582]

The archetypes function as *instincts of apprehension*; contact with an archetypal conception therefore directly conveys a feeling of conviction and evidence. Other thinkers and scientists have given this feeling of evidence names like 'intuition' (Poincaré) or 'a priori synthetic judgement' (Kant). The experience of this certainty is a vital component of Jung's definition of the archetype. He calls it the experience of *numinosum*, or a vivid sudden insight. It is the experience of 'everything falling into place', sometimes accompanied by seeing life in an entirely new perspective. In this context Pauli refers to his experience as a twelve-year-old, when he suddenly with an immediate and undoubting certainty understood the parallel postulate of Euclid. This feeling of evidence exists prior to thought, it 'strikes' one, says Pauli. It is then the task of intellectual thought to work through and confirm an idea and ultimately also to doubt what was once so evident. Applying this perspective

[581] The early Christians still had this view.
[582] Pauli, 'Ideas of the Unconscious', *WPP*, 161.

Pauli sees the possibility of reconciling the categories of 'true' and 'false' as well as *episteme* (rational knowledge) and *ennoia* (mystical knowledge). They are at opposite ends of a scale that belongs to one and the same process.[583] Pauli would further develop this central theme in his correspondence with Jung and others.

The first subject that Pauli discusses with Jung is thus the relationship between the conscious and the unconscious. According to Pauli this relationship, as it is described in the psychology of Jung, may be compared with the epistemological situation in physics. Pauli's colleague Markus Fierz has, in much the same way as Pauli, commented on this issue in his lecture *Zur Physikalischen Erkenntniss*. In view of the history of science, he says, it is possible to see a parallel development in the two disciplines of physics and psychology.

> In the very year (1900) in which Planck took the first step towards the quantum theory, the 'Interpretation of Dreams' by Sigmund Freud (1856–1939) appeared. The unconscious was recognized as a concept for empirical research.
>
> Freud adopted the empirical viewpoint of the natural sciences and thus overcame the prejudice that dreams were nonsense. With this he obtained the recognition of a new field of experience. Depth psychology soon progressed beyond its original, purely medical boundaries and acquired decisive importance in the humanities. In this development it appears to me that Carl Gustav Jung's book 'Wandlungen und Symbole der Libido' (1912), was a milestone comparable to the classic works of Niels Bohr.[584]

Fierz considers that the parallel development of these disciplines must be due to the changing mentality of contemporary man. In their respective fields of research, both disciplines have penetrated new, non-visual areas. Psychology has discovered the unconscious and physics has discovered the world of microphysics. Both disciplines respectively suffer from a *King Midas syndrome*: there are no boundaries to what physics believes it can explain with its methods – everything it touches becomes the gold of physics. The same applies in psychology, whose newly acquired perspectives transform everything it encounters into psychology. Instead of pursuing this 'totalitarian' and conquering approach they should see themselves as complementary images of a common reality, despite the fact that they cannot yet be reconciled in a unified worldview.

Pauli's first publication of a more philosophical character touches on this subject. In a lecture given in 1949, *Die philosophische Bedeutung der Idee*

[583] Pauli to Hecke, 20 Oct. 1938 [534], *PLC II*, 605.
[584] Fierz, 'Zur Physikalischen Erkenntnis', *Naturwissenschaft und Geschichte*, 25.

der Komplementarität (The Philosophical Significance of the Idea of Complementarity), he deals with the central philosophical theme of the complementarity principle: the relationship between subject and object. He refers to Bohr's *Atomtheorie und Naturbeschreibung* (The Quantum of Action and the Description of Nature) and especially to the passage where Bohr states that a conscious analysis of a concept is irreconcilable with its simultaneous application.[585] He accepts Bohr's cane analogy and the gliding relationship between subject and object. In Pauli's view the term *consciousness* always requires a demarcation between subject and object. The demarcation is a logical necessity, but its position is more arbitrary. Without this demarcation one ends up with two kinds of metaphysical extrapolation, which stand in a complementary relationship to each other. One extrapolation is the naively realistic, which demands that the nature of the object must be independent of how one observes it. The other coincides with the metaphysics of the pure subject of knowledge, as occurs in, for example, Hinduism. There it is been 'realized' that all objects are *maya* (illusion) and therefore one is no longer confronted with an object. Pauli continues:

> The western mind (*abendländischer Geist*) cannot accept such a conception of a supra-personal cosmic consciousness without a corresponding object, and must hold the middle course prescribed by the idea of complementarity. Regarded from this point of view a duality of subject and object is already postulated by the concept of consciousness.
>
> In the place of the oriental universal consciousness lacking an object, western psychology has set up the idea of the unconscious, whose relation to consciousness exhibits paradoxical features similar to those we meet in physics. On one hand modern psychology demonstrates a largely objective reality of the unconscious psyche; on the other hand every bringing into consciousness, i. e. observation, constitutes an interference with the unconscious contents that is in principle uncontrollable; this limits the objective character of the reality of the unconscious and invests reality with a certain subjectivity.[586]

Here we recognize Pauli's main theme: a modern Westerner cannot accept a consciousness without an object, any more than he – since the advent of quantum physics – can accept the idea of an object independent of consciousness. It is the Westerner's duty to *find the middle way*. A concept such as consciousness assumes the duality of subject and object from the outset. Pauli finds that the modern psychological concept of 'the unconscious' is a more fruitful notion than the oriental objectless universal consciousness.

[585] Pauli, 'The Philosophical Significance of the Idea of Complementarity', *WPP*, 41; Bohr, 'The Quantum of Action', *Collected Works of Niels Bohr*, vol. 6, 212.

[586] Pauli, 'The Philosophical Significance of the Idea of Complementarity', *WPP*, 41–42.

In particular there are two essential features in the new perspective of modern (i. e. dynamic) psychology that resemble the situation in physics. With the help of the word association test, psychology has been able to demonstrate by experimental means the objective reality of the unconscious psyche, i. e. the existence of emotionally charged complexes. Moreover it has called attention to the universally occurring conceptual motives. At the same time psychology has shown that every observation of a previously unconscious content – that is, every increase in consciousness – involves an interference with the unconscious contents that is in principle uncontrollable; this limits the objective character of the reality of the unconscious and invests it with a certain subjectivity. In saying this Pauli accepts Jung's observation that the archetype represents a certain universal structure that nevertheless always expresses itself in an individual form. A negative father complex, for example, may be described in general terms, but in each individual the father complex will always acquire characteristics from the personal life experience.

Pauli points at two principles that are operative in both modern physics and modern psychology: *indivisibility* and *wholeness*. In physics this concerns the impossibility of arbitrarily separating the measuring instrument from the measured object within the framework of the physical phenomenon. This is compared with the indivisible wholeness of consciousness and the unconscious in the human psyche. Both disciplines also focus on the act of observation: it *constitutes an incalculable intervention*. In physics it is the uncontrollable interaction between the measuring device and the observed system and in psychology the awareness that every expansion of consciousness implies an unpredictable change in the whole mental system. Here we have something of real importance to Pauli: finding underlying principles that apply in *both* psychology and physics. This was what he meant when he said that one 'must neatly keep one's nose complementarily in the middle' if one wants to approach the mysterious relationship between the 'inner' and the 'outer'. This was meant as a dig at Jung, who had a tendency to explain everything in terms of the projections of the psyche.[587] A truly symmetrical relationship requires that the concept of *introjection*, in other words information from the outside world to the psyche, be accorded as much importance as the concept of *projection*, contents flowing from the psyche to the world.[588]

The most urgent question to Pauli was how he might profitably bring the insights provided by Jungian psychology to bear on his own discipline

[587] Pauli to Fierz, 2 Mar. 1948 [940], *PLC III*, 512.
[588] Pauli to von Franz, 16 Oct. 1951 [1291], *PLC IV/1*.

– physics. There were three areas in particular which occupied Pauli's mind and which he believed he could see in a new light with the aid of Jung's model:

1. The epistemological puzzle of the relationship between sensory impression and concept formation;
2. An understanding of the emergence of the Western worldview in the context of the history of science;
3. The possibility of an integrated worldview that is capable of including insights into both our mental and our physical reality.

All these themes are touched on in Pauli's essay on Kepler, even if only in passing.[589] We obtain a clearer picture of them from the correspondence and from Pauli's essay on 'background physics', an essay that has only now become available in conjunction with the publication of the correspondence of Pauli and Jung.

[589] Wolfgang Pauli, 'The Influence of Archetypal Ideas on the Scientific Theories of Kepler' (1952), *WPP*, 221.

Kepler, Fludd and the World Soul

I have been unable to establish the precise origin of Pauli's interest in Johannes Kepler, but his teacher Arnold Sommerfeld had already opened his eyes to Kepler and his numerical mysticism. As early as 1938 Pauli refers to Kepler's idea of an *anima terrae* (soul of the earth) in a letter to his close friend Erich Hecke.[590] With a background in medieval and renaissance Platonism, the art historian Erwin Panofsky played an important part in the matter. In his speech on the occasion of the Nobel festivities held at the *Institute for Advanced Study* in 1945 to celebrate Pauli's Nobel Prize , Panofsky recalled how impressed Pauli had been by a reading of Kepler. He then spoke about Kepler at length. Panofsky and Pauli had already met in Hamburg in 1928, where Panofsky held the chair of history of arts at the newly opened University of Hamburg. Pauli got to know him there when working with Wilhelm Lenz at the Institute of Theoretical Physics. Their friendship deepened at the *Institute for Advanced Study* where they met again in 1940 (Panofsky had been there since 1935 in the Humanities Department). In Princeton Pauli had an excellent opportunity to study Kepler as his works were available in the library of the Institute. Panofsky also helped him throughout his work with advice on the history and the sources of ideas. He later also advised Pauli on the source material concerning Robert Fludd.[591]

Pauli took up his work on Kepler again in 1946. Two impressive dreams and his discovery of the Rosicrucian alchemist Robert Fludd and his criticism of Kepler's quantitative approach to science reawakened his interest. This resulted in Pauli giving two lectures on the influence of archetypal ideas on the scientific theories of Kepler in February and March 1948 at the psychological club in Zürich.[592] The study was later published together with Jung's essay on synchronicity in 1952. In his preface Pauli also thanks Jung, C.A. Meier and Marie-Louise von Franz for their help. The letters show that Pauli engaged in lively discussion on the subject with them, particularly on the psychological aspect. It is hardly probable that Pauli was directly inspired by Jung to write

[590] Pauli to Hecke, 20 Oct. 1938 [534], *PLC II*, 605.

[591] Enz, *No Time to be Brief,* 417. See also *PLC IV/1, footnote 2 to letter [1160], 177.* Pauli refers to discussions with Panofsky in the preface to the English edition of his essay. Pauli, 'The Influence of Archetypal Ideas', *WPP*, 220.

[592] Pauli to Jung, 16 Jun. 1948 [34P], note a, *PJL*, 34.

about Kepler, even if Kepler uses the term *archetypus* to explain how it can be possible for man to obtain an insight into the riddles of the universe. Kepler advances arguments resembling those of Plato to suggest that man's soul, as a replica of God's spirit, has been impregnated at the moment of creation with the divine ideas or forms which constitute the foundations of the whole universe. These archetypes are of a geometrical and mathematical nature. However, Jung himself never connected the concept of the archetype with Kepler. He said rather that he had taken his understanding of the archetype from the hermetic-gnostic sphere.[593]

Pauli relates in a letter to Jung that a dream at the end of October 1946 had such a strong effect on him that he had to turn to Kepler again. Here we again find the central motifs of rotation and cosmic rays. In the first dream of October 25, he receives a casket through the post. Inside there is an apparatus for the experimental investigation of cosmic rays. Next to it stands a tall, blond man of between 30 and 40. He says that Pauli must force the water up higher than the houses in the city so that the city dwellers will believe him. Behind the apparatus in the box he then sees a bunch of keys, eight in all, arranged in a circle with the key bits pointing downwards. As a comment on the dream he remarks that he has had earlier dreams where a dark, male figure – called the 'Persian' – occurs who is not accepted as a student at the ETH. Pauli interprets him as a contrast to the prevailing scientific collective attitude . He thinks that 'the blond' and 'the Persian' may be two aspects of one and the same figure, like the *Mercurius duplex* of the alchemists. They both have an extremely 'psychopompos' character, i. e. that of a spiritual guide. He calls this figure 'the stranger'.

The next dream, of October 28, reads:

> The 'Blond' is standing next to me. In an ancient book I am reading about the lnquisition trials of the disciples of the teachings of Copernicus (Galileo, Giordano Bruno) as weIl as about Kepler's image of the Trinity. Then the Blond says: 'The men whose wives have objectified rotation are being tried.' These words upset me greatly: The Blond disappears and to my consternation the book also becomes

[593] In his earliest texts Jung refers to St.Augustine as a source of the archetype concept. In 1954 he reports as his sources the Greek theologian St. Irenaeus, whose *Adversus haereses* renders the ideas of the gnostics. He also refers to *Corpus Hermeticum* and to Dionysius the Areopagite's *De divinis nominibus*. It is known that Jung had read about the gnostics even before he wrote his doctoral thesis in 1902. Cf. C.G.Jung, 'Instinct and the Unconscious' (1919), *Contributions to Analytical Psychology* (London, 1928), 279, (Cf. *C.W.*8, §275); idem, 'The Archetypes and the Collective Unconscious', *C.W.*9*I*, §5; idem, 'On the Psychology and Pathology of So-called Occult Phenomena', *C.W.*1, §149. According to Panofsky the earliest written record of the term archetype is found in Cicero's letters to Atticus dating 67–43 B.C. where it means 'original' as opposed to 'copy' and 'master' to be used in the reproduction of publications. He probably took it from a Greek source. Panofsky to Pauli, 18 September 1951 [1280], *PLC IV/1*.

> a dream image: I find myself in a courtroom with the other accused men. I want to send my wife a message and I write a note: 'Come at once, I am on trial.' It is getting dark, and for a long time I cannot find anyone to give the note to. But finally a Negro comes along and says in a friendly way that he will deliver the note to my wife. Soon after the Negro has left with the note, my wife turns up in fact and says to me: 'You forgot to say good night to me.' Now it starts to get lighter, and the situation is as it was at the beginning (except that my wife is now present, too): The 'Blond' is standing next to me once more, and I am reading the ancient book again. Then the Blond says to me sadly (apparently referring to the book): 'The judges do not know what rotation or revolution is, and that is why they cannot understand the men.' With the insistent voice of a teacher, he goes on to say: 'But you know what rotation is!' 'Of course' is my immediate reply, 'The revolution and the circulation of light – all that is part of the basic rudiments.' (This seemed to be a reference to psychology, but the word is never mentioned.) Whereupon the Blond says: 'Now you understand the men whose wives have objectified their rotation for them.' Then I kiss my wife and say to her: 'Good night! It is terrible what these poor people who have been charged are going through!' I grow very sad and start crying. But the Blond says with a smile: 'Now you've got the first key in your hand.' At this point I woke up and was quite shaken. The dream was an experience of a numinous character and has deeply influenced my conscious attitude.

Pauli connects this dream with the anima problem, not only his own but the one in sciences in general. In the seventeenth century something decisive happens in the transition from the hermetic to the classical, mechanical worldview. It concerns the exclusion of the feminine and the soul from matter. Rotation is a typical symbol of the mandala: it is associated with the centring processes that lead to wholeness. To understand 'rotation' means to understand the function of the soul (anima) in science. In the seventeenth century the mandala ceases to belong to the inner world, where its function was to integrate the different aspects of existence (body, soul, God and Cosmos). Now the mandala with its 'rotation' is instead projected into outer space in Kepler's vision of the solar system. The soul has begun its exodus from nature, which is doomed to turn into dead matter. The soul is cast into the shackles of subjectivity and the scientist becomes unaware of her (the soul being seen as feminine) function in the cognitive process. When Pauli cries compassionately for the accused he receives the first key. Feeling is the first key to the new understanding of nature and science.[594]

One more source of inspiration to study Kepler had come from reading Markus Fierz' essay on Isaac Newton, written in 1943.[595] Newton seems to have

[594] Pauli to Jung, 25/28 Oct. 1946 [32P], *PJL*. This dream has some themes in common with a dream of Descartes, where an unknown man appears in connection with strangely emerging and disappearing books. Descartes seems to have interpreted this dream also as concerning the basic questions of the relationship between science and art. C. Adam and P. Tannery, *Oeuvres de Descartes* (Paris, 1908), vol. 10, 182 ff.

[595] Pauli to Fierz, 29 Dec. 1947 [926], *PLC III*, 489; Markus Fierz, 'Isaac Newton, sein Character und

been closer to the deists in his conception of God and had no time for the doctrine of the Trinity. The deists did not recognize the divine nature of Christ. According to Fierz, Newton's conception of God permeated his entire scientific work: God's universality and eternity express themselves in the dominion of the laws of nature. Time and space are regarded as the 'organs' of God. All is contained and moves in God but without having any effect on God himself. Thus space and time become metaphysical entities, superordinate existences that are not associated with any interaction, activity or observation on man's part.[596] This absolute view of space and time is carried on by Immanuel Kant who despite his otherwise sharp epistemological perception considers these two as fundamental categories of the mind, which are therefore incapable of further reduction and so determine man's view of the world. After reading Fierz' essay Pauli became interested in the way the world was seen before Newton elevated space and time to the status of divine instruments. He therefore began to immerse himself in the worldview of the seventeenth-century in general and in Kepler in particular.

> In the meantime I have continued my excursion to the seventeenth century. The fact that Newton has placed space and time on the right hand of God, as it were, and indeed in the place vacated by the son of God when banished by Newton, is a particularly piquant aspect of intellectual history, of which I have only learned from reading your Newton lecture. As you know a quite remarkable effort was needed to bring space and time back down from this Olympus. However the task was made considerably more difficult by Kant's philosophical attempt to deny human reason any access to this Olympus.
>
> Because of this I am particularly interested in the time when space and time were *not yet* up there and indeed the moment just *before* this fateful operation. Hence my study of Kepler.[597]

By analysing the conflict between Kepler and Fludd, Pauli hoped to get closer to the mind of the early seventeenth century. As I cannot go deeply into Pauli's study of Kepler and the seventeenth century here, I shall only summarize Pauli's presentation of the radical differences between the innovative ideas of Kepler and the antiquated worldview of Fludd.

1. *Differing Views of the Value of Quantitative Methods*. Kepler's argument for a quantitative perspective, i. e. that the soul is emotionally receptive to the divine proportions (geometry), is rejected by Fludd. To Fludd, who was a hermetic and an alchemist, diversity – in other words the quantitative – is associated with the principles of matter and darkness. Following

seine Weltansicht', *Vierteljahrsschrift der Naturforschenden Gesellschaft in Zürich* 88 (1943), 198–216.

[596] Fierz, ibid., 198–216.

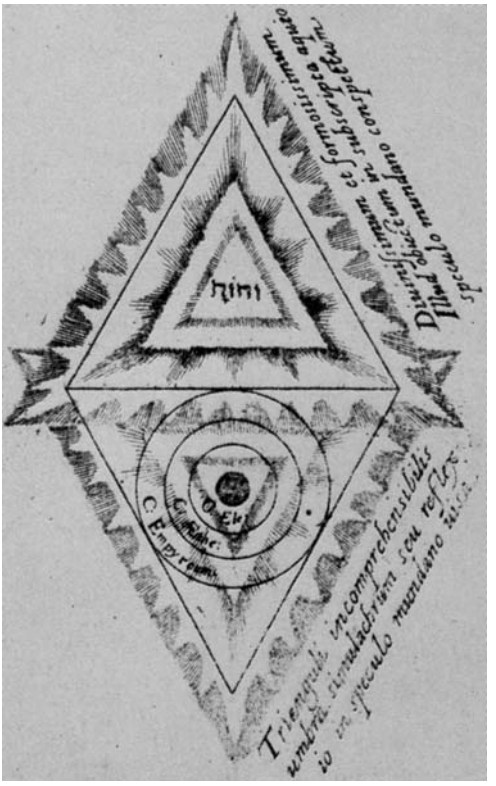
[597] Pauli to Fierz, 29 Dec. 1947, *PLC III*, 488–489.

Pythagoras he regarded 'the One' as divine, while duality represents the dividing of the one into a multiplicity and was therefore associated with the devil, who ensnares the soul in the dark world of the senses. Fludd contrasted the quantitative method, which he called 'vulgar mathematics', with 'formal mathematics', which meant the contemplation of the unified and 'the pure forms'.

2. *Differing Views of the Place of the Soul in the Universe*. To Kepler the soul is a part of nature, which, however, just like the rest of animate nature (*anima terrae*), is in a receptive relationship to the specific proportions which express the divine geometrical ideas (the archetypes). To Fludd the concepts of 'soul' and 'part' are irreconcilable. The soul is regarded fully in accordance with hermetic tradition as indissolubly united with the soul of the whole world (*anima mundi*). In Fludd's worldview it is absurd to speak of the soul as a receiver in relation to divine ideas as the soul and the ideas are identical. In Kepler the soul becomes almost a mathematically describable resonance system, whereas Fludd still includes the emotional values in his perception of it.
3. *The Subject/Object Relation and the Holistic Worldview*. Fludd still tried, with the help of his hieroglyphic figures, to express the unity between the observer's inner perception of the natural processes and the external, factual natural processes themselves. Fludd thus tried to retain the holistic perspective in the description of nature, a perspective that had been expressed in the analogy of the microcosm and the macrocosm. This idea then of course disappeared entirely with the emergence of classical physics. The notion of the world soul (*anima mundi*) was admittedly retained by Kepler, but only as a kind of relic. He placed considerably greater weight on the individual souls, that is to say the sensitivity to proportion of the individual celestial bodies (who were considered as having soul).
4. *Trinity-quaternity*. In his analysis, Pauli focused on the importance of the numbers three and four in the universe as conceived by Kepler and Fludd respectively. According to Pauli, Kepler had based his whole system on the principle of the trinity in association with the Christian faith. Fludd, on the other hand, who went back to an alchemist tradition, worked with the number four. Pauli here brought in Jung's exposition of the psychological significance of the Christian trinity in contrast to the figure four, which Jung had observed as a spontaneous and natural expression of wholeness.

Trinity, Quaternity and the Mandala

In his Eranos Lecture of 1940–41, and in more detail in 1948, Jung developed his ideas on the distinguishing features of the numbers three and four.[598] His basic assertion is that in most cultures the figure four has since time immemorial expressed a complete description. To give a complete description of our horizon we use four points of the compass, the Greeks divided the world into four elements, society was divided into four estates and so on. The circle, which is also a symbol of totality, is divided into four parts with the aid of the cross. Jung particularly noted that the number four seems



The divine and the wordly triangle. Rober Fludd, Utriusque cosmi … historia, Oppenheim 1617. The shadow of the incomprehensible trinity is reflected in the world – the spiritual and the material area are a reflection of each other. The pattern forms a hexagon that consists of two triangles but can also be seen as a trapezoid rectangle[599]

[598] Jung, 'A Psychological Approach to the Trinity', *C.W.*11, §169 ff.
[599] Illustration from Pauli, 'The Influence of Archetypal Ideas', *WPP*, 245. Courtesy Springer Verlag.

to stand for wholeness and orientation, but also that the number four and the number three often stand in a complementary relationship to each other. He used the concepts of *trinity* and *quaternity* when discussing the relationship between these configurations.[600]

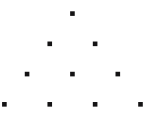
An example of such a quaternary structure is the *mandala*, a symbolic form that especially interested Jung. The word 'mandala' is Sanskrit, and means a sphere or a zone which is at the same time a container. A mandala is in the strict sense a figure of concentration and meditation that can be found in Indobuddhist culture and elsewhere. It is distinguished by geometrical forms of great complexity, which are primarily based on the relationship between circles and squares, and it is meant to reveal the cosmic order. Jung considered that these mandalas reproduce the centring processes of the psyche, in other words its intrinsic striving for order and wholeness, and can therefore be found in all cultures. There exist an abundance of examples of such mandalas. e. g. the sand paintings of the Navaho Indians, the medieval mandorla with Christ in the centre and the four evangelists in the corners, the wheel cross and many others. A cross, wheel or petal-like rosette form with a clear quadruple tendency or some sort of rotational dynamics is nearly always involved.[601]

What is characteristic of the West is that these centring processes often express themselves in religious, philosophical or scientific texts, in other words on a conceptual or abstract level rather than a figurative one. What is most characteristic is that these mandala forms attempt to reconcile opposites: the circle and the square, the static and the dynamic, the dark and the light. They are often on a high plane of abstraction and make use of different proportions and numerical ratios. One such example is the *tetractys* of the Pythagoreans.[602] Jung was struck by the fact that his patients spontaneously painted or otherwise portrayed such mandala forms when they were approaching an inner stability and harmony after, for example, depression. But these totality figures can also appear as compensation at times of temporary confusion and imbalance.[603]

[600] Idem, 'The Psychology of the Transference' (1946), *C.W.*16, §405 ff.

[601] In Chinese texts this centring process is described as 'the circulation of light'. Jung & Wilhelm, *The Secret of the Golden Flower* (1929), 2nd ed. (London, 1962), 30 ff. Jung, 'Commentary on ›The Secret of the Golden Flower‹', *C.W.*13, §31 ff.

[602] Ibid., §61–62. The Pythagoreans considered the number four to be holy; it is the most perfect number and the root of all things. It was associated with God and with the human soul. Tetractys was depicted like this and revealed the sum of the first four numbers: 1+2+3+4=10. In addition 36 was considered sacred because it forms the sum of the first four even and uneven numbers (1+3+5+7 = 16, 2+4+6+8 = 20).



[603] Idem, 'The Psychology of the Transference' (1946), *C.W.*16, §405 ff.

Mandala picture by a seven year old[604]

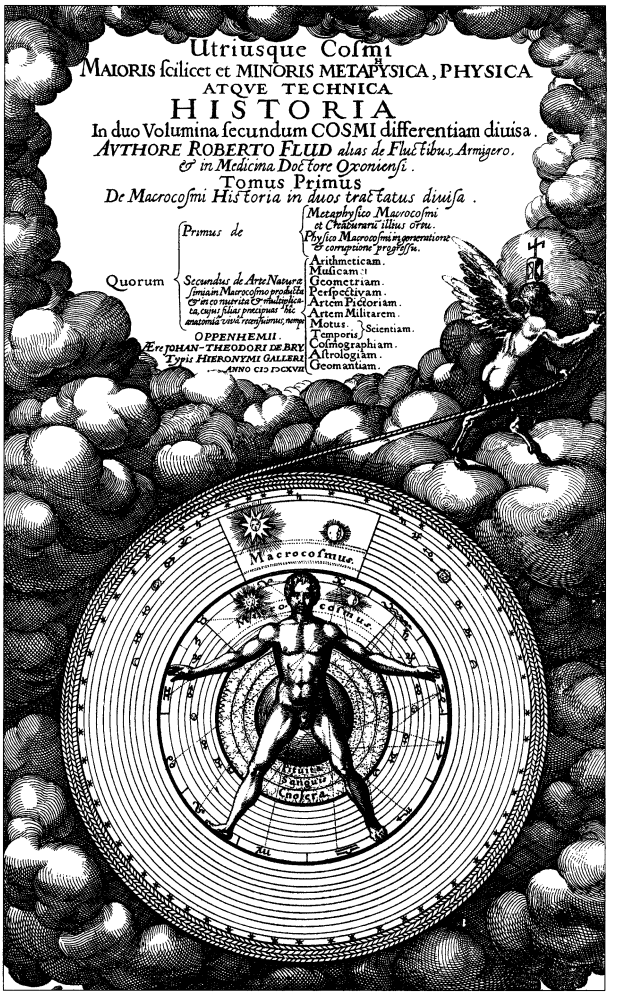
According to Jung the Trinity is not a natural scheme of things but a construction. He arrives at the conclusion that systems of ideas based on threes often form rationally expressible images of reality. At the same time they exclude the irrational side – in other words that part of reality, which does not fit in with our schemes. This idea is also developed by Jung in his model of the psychological types, in which he considers that an individual is capable of differentiating at most three of four possible functions: thinking, feeling, intuition and sensation. The remaining function, which is in opposition to the 'main function', always remains 'archaic' and contaminated by the unconscious. However this archaic function performs the immensely important task of linking the individual with the unconscious and thus guaranteeing a renewal of the whole personality.[605] The fourth will therefore once again become 'the one', because the fourth function summarizes the other three in a greater whole.[606] According to Jung, therefore, there is an archetypal relationship between the numbers three and four. Jung envisaged the number three as associated with processes in time and space and with the realization of a potential. For this reason the number three can also be connected with consciousness. The 'fourth' is then the still unrealized or unconscious, the part still missing from a *complete* picture. From that point of view the number four is an always unrealizable totality for which we are constantly striving.

Integrating the fourth component, or defining one's attitude to it, is always a big problem. Internally there is the corresponding difficulty of accepting certain sides of oneself that are not in accordance with the cherished self-image. Jung has called work on this side 'insight into the shadow'. Jung

[604] Picture from a book by Micheal Fordham, *New Developments in Analytical Psychology* (London, 1957), page 134. Courtesy Michael Fordham estate.

[605] Idem, 'Psychological Types', *C.W.*6, §670, 763; idem, 'The Transcendent Function', *C.W.*8, §131 ff.

[606] Jung refers here mainly to the ideas of the gnostics and alchemists. i. e. the saying or the Axiom of Maria the Prophetess (also called the Jewess, Copt or Moses' sister): 'The one becomes two, the two become three and from the third arises the one as the fourth'. Idem, 'Psychology and Alchemy', *C.W.*12, §26.



Title page from Fludd's 'Utriosque cosmi… historia', Oppenheim 1617[607]

believed that this 'insight into the shadow' is man's most challenging problem, on both the individual and the collective level. On the collective level the problem is related to man's self-image as it is formulated in his philosophy and religion. The shadow is always coloured by what is not accepted or sanctioned in a culture, while at the same time it contains potentials which have not yet been developed.

The shadow is always *irrational* in the sense that it does not 'fit into' the official worldview. In this way everything that is devalued and excluded goes down the same sink – summarized as a single undifferentiated abomination.

[607] Illustration from Pauli, 'The Influence of Archetypal Ideas', *WPP*, 245. Courtesy Springer Verlag.

Mandala of Vajrabhairava, the conqueror of death, 1600-1700. Tibet; Ngor Monastery. Colors on cotton. The Avery Brundage Collection, B63D5. © Asian Art Museum of San Francisco. Used by permission

From this perspective it is not difficult to understand why the good, the rational, the masculine and the spiritual have been linked in our culture, while the evil, the feminine, the irrational, and the material have been pushed into the shadow. But at the same time there have always existed cultural undercurrents and sub-cultures in which the shadow is seen as the essential precondition of man's wholeness.

In *Psychology and Religion* Jung deals among other things with Pauli's dreams and visions. Jung was particularly interested in Pauli's vision of 'the great world clock', which displays a clear mandala structure. According to Jung this vision marked a turning point in Pauli's psychological development and gave him, as he himself said, 'the impression of the most sublime harmony'.[608]

What Jung found remarkable and significant with Pauli's mandala was that the centre, which in the traditional religious mandala usually contains

[608] Jung, 'Psychology and Religion', *C.W.*11, §110. The vision is the following: There are a vertical and a horizontal circle with a common centre. This is the world clock. It is borne by the black bird (reference to earlier dreams). The vertical circle is a round blue disc with a white edge and is divided into $4 \times 8 = 32$ parts. On it rotates a pointer. The horizontal circle is of four colours. There are four little men with pendulums on it and around it is the ring which was once dark but is now golden (refers to an earlier dream in which the ring was carried by four children). The world clock has three rhythms or pulses:

1. The little pulse: the pointer on the vertical blue disc advances by 1/32.
2. The medium pulse: the pointer makes a complete rotation while the horizontal circle advances by 1/32.
3. The large pulse: 32 medium pulses correspond to a complete rotation of the golden ring.

Pauli's world clock[609]

a divine figure, is in this case empty or replaced by a mechanism. Jung said that he had been struck by this in several of his patients.

> . . . I have found the same fact in an overwhelming majority of cases: there was never a deity occupying the centre. The centre, as a rule, is emphasized. But what we find there is a symbol with a very different meaning. It is a star, a sun, a flower, a cross with equal arms, a precious stone, a bowl filled with water or wine, a serpent coiled up, or a human being, but never a god.[610]

Jung believed that the modern mandala expresses the religious attitude of modern man and also creates a relationship with the highest and most powerful values. According to Jung 'The psychological fact that exerts most force in your system functions as a deity'.[611] What is interesting is that people see the central symbol in the mandala as the symbol of their own innermost centre. This experience is expressed in words such as: to find oneself, to be able to accept oneself, to be reconciled with oneself and thus with the circumstances which have befallen one. One might say that one has become reconciled with God. However the modern mandala speaks clearly; the aim is no longer to be

[609] A drawing by W. Byers-Brown, from F. David Peat, *Synchronicity: The Bridge Between Matter and Mind* (London, 1987), 19. Courtesy W. Byers-Brown. Coloured by the author.
[610] Jung, 'Psychology and Religion', *C.W.*11, §137.
[611] Ibid., §137.

reconciled with or to submit to a specific God; the place of the deity has been taken by something symbolizing the wholeness of the individual.[612] Pauli marked these passages in his own copy of *Psychologie und Religion*.[613] Time and again he returns to this theme in his correspondence, where he speaks of *Zentrum der Leere*, the centre of the void. Pauli associated the vacant centre with the 'modern' viewpoint as described above: the divine principle is no longer a 'thou', it can no longer be credited with consciousness. Modern religious belief is characterized by a non-visual, non-anthropomorphic idea of God.

Pauli summarizes his notion of God in a letter to Marie-Louise von Franz:

> As far as my own conception of God (if it can still be called that at all) is concerned, God is to me identical with the order of the cosmos (not simply with the world as for the pantheists). In contrast to church religion, however, I believe that our ideas of the cosmic order should remain unprejudiced, both with regard to the utility of the (narrower) causality principle (determinism) and to its implications, and also to the admissibility of an anthropomorphic concept of consciousness in this context. (In the latter respect I remain true to Schopenhauer).[614]

It was in this respect that Pauli was attracted by oriental philosophy – including Hindu philosophy, but more especially Chinese philosophy. Here Pauli often quoted Lao Tse: 'Heaven and earth are ruthless, and treat the myriad creatures as straw dogs'. To Pauli this quotation expressed the only divine image which he could come to terms with: the principle that guides our universe treats its creation with no consideration of our petty definitions of good and evil.[615] On several occasions Pauli emphasized that he believed in an invisible reality beyond human consciousness.[616] But if a divine principle is to be maintained it must coincide with the numinosity of

[612] Ibid., §136, 139.

[613] Jung, C.G., *Psychologie und Religion. Die Terry Lectures 1937 gehalten an der Yale University* (Zürich, 1940). The book is in 'La Salle Pauli' at CERN, Bellettrarisches No. 100.

[614] Pauli to von Franz, 22 Feb. 1951 [1205], *PLC IV/1*.

[615] The whole passage reads as follows (in translation):
'Heaven and earth are ruthless, and treat the myriad creatures as straw dogs;
The sage is ruthless, and treats the people as straw dogs;
Is not the space between heaven and earth like a bellows?
It is empty without being exhausted:
The more it works the more comes out.
Much speech leads inevitably to silence.
Better to hold fast to the void. (V)'
Lao Tzu, *Tao Te Ching*, V (Harmondsworth, 1963), 61. Straw dogs were used in sacrificial rituals, where they were treated with the greatest respect before being sacrificed, and then thrown away and trampled on.

[616] Pauli to Fierz, 12 Aug. 1948 [971], *PLC III*, 559; Pauli to Bohr, 3 Oct. 1950 [1158], *PLC IV/1*.

the unconscious. Such a God is not 'omniscient' and no *prima causa* but manifests himself both in the alternating causal processes and in the acausal contexts.[617]

The overriding question is therefore: How does one get from three to four? Pauli writes to Fierz that he wrestled with the problem of the relation between three and four long before he met Jung, when he was working on his exclusion principle in the 1920s. The exclusion principle is in fact based on the problem of the transition from three to four. To the three existing electronic states a fourth element of spin was added. The introduction of this fourth quantum number was the most difficult part of the formulation of the principle.

> My way to the Exclusion Principle had to do with the difficult transition from three to four, namely with the necessity to ascribe to the electron a fourth degree of freedom (soon explained as 'spin') beyond the three translational ones. To bring myself to recognize, against all naive pictures, that the fourth quantum number is a property of *one* and the same electron (besides the known three quantum numbers now designated n_r, l, m_l, [the old n, k, m,]) – that was really the chief thing.[618]

If one assumes that the number four represents a complete ordering system, there is reason to wonder – for example in connection with the Christian trinity – where the fourth has gone. Jung's reply is that the 'fourth' in Christianity has become associated with evil, because the trinity has become a *summum bonum*. To the extent that the quaternity is included in Christianity – in the form of the cross – it is associated with the suffering of the Godhead in this world. Pauli apparently found this analysis of trinitarian and quaternarian thinking interesting and also found support for it in his study of the conflict between Kepler and Fludd. Kepler's ideas of course mark the transition to what we today call the classical scientific worldview. Pauli therefore had a direct interest in studying what distinguished Kepler's ideas from Fludd's. In Kepler he found that the doctrine of the Trinity had played an enormous part in forming his scientific worldview.

Strongly influenced by the doctrine of Agrippa von Nettesheim and Paracelsus regarding the *signatura rerum*, Kepler saw the external form of objects as an expression of a deeper, not directly observable, layer of reality. This view of reality was hierarchical; he placed the non-visual Christian Trinity highest and then saw all other layers of reality as different depictions of the higher one. The most beautiful image, which reveals God's true being, is the

[617] Pauli to von Franz, 22 Dec. 1951 [1328], *PLC IV/1*.

[618] John Heilbron, 'The Origins of the Exclusion Principle', *Hist. Studies Phys. Sci.* 13 (1983), 309. Cf Pauli to Fierz, 3 Oct. 1951 [1286], *PLC IV/1*.

three-dimensional sphere: the father in the centre, the son on the surface and the holy spirit as the proportional relationship between the centre point and the circumference. Movement or emanation from the centre to the surface then becomes the symbol of the Creation, while the curved surface symbolizes the eternal nature of God. The straight line is linked in this way with the material world, whereas the curved line is more perfect than the straight because it symbolizes the soul or the spirit. The geometrical proportions belong to the innermost essence of the deity and are eternal and true; they constitute cosmic archetypes. The human soul is a lower image of the divine spirit and is in the same relation to God as the circle to the sphere. The human soul therefore bears traces of the divine ideas and all knowledge consists in bringing together the external observations and the internal ideas. If they agree with each other, knowledge or insight results, which is experienced as an awakening from sleep – a description which Kepler took from his favourite author Proclus.

The material world is also a depiction of this highest order: the heliocentric universe, with the sun in the middle and the planets around, corresponds to Kepler's spherical image of God. The radiation of heat and light from the sun is analogous to the linear emanation of the Creation from God the father. On the basis of this image Kepler formulated his photometric law, which states that luminous intensity is in inverse proportion to the square of the distance from the imaginary point source. The formulation of this law brought him very close to the discovery of the law of gravity. Kepler also connected the trinity with the three-dimensional nature of space.

However the important thing to Pauli was to underline that it is the symbolic picture of the trinity that lies behind Kepler's scientific ideas. This is what leads him to argue with a religious passion for a heliocentric worldview. The emergence of classical science should not therefore be seen in the context of a struggle between religion and science, but rather as the outcome of a battle between a new conviction and an old. Here Pauli accepts Jung's idea: when an old conviction dies, this is a sign that it no longer fulfils its function as a living symbol. A symbol consists of course, according to Jung, of a rational part which has to reveal or explain reality, but also of *numinosum* – in other words an irrational part which conveys a feeling of respect, meaning and conviction. The ultimate cause of the death of a symbol is that it is 'exhausted', in other words so thoroughly worked out, so insipid, that nothing new seems to emerge from it. For that reason the death of the symbol is definitely connected with the need for a new perspective, indeed with a change and expansion of consciousness and knowledge. The origin of the scientific view of the universe thus meant not only the replacement of one conviction by another conviction,

but a change in perspective. It is not a question of a simple linear evolution in which science prevails over the 'superstitious' Middle Ages, because every change of perspective also entails a certain *loss* of knowledge.

Pauli emphasized that the emergence of classical mechanics was basically a turning outward of the centring symbolism in an 'extraverted' form, 'projected' into the firmament. Here this external structure was assumed to function as an automaton which the human mind can observe and comprehend. But Kepler's mandala – with its point, surface and circumference – is trinitarian and not quaternarian. Pauli therefore wondered what was missing from Kepler's worldview and whether the lack of a time dimension could be linked to the lack of 'the fourth'. The only movement in Kepler's picture of the world is the perpendicular emanation from centre to surface; the motion is captured by the surface, and therefore Kepler's worldview has to be regarded as static. Fludd's perspective, on the other hand, is based in accordance with hermetic/Pythagorean philosophy on the number four. Fludd felt that he had to defend the number four against Kepler. The number four, *Quaternarius* or *Tetragrammaton*, is God's own attribute and is expressed in the four Hebrew letters which make up God's unspoken name. Fludd also referred to the four elements, the four seasons, the four points of the compass and so on. The four elements are also connected with man's different abilities: being, living, feeling (perceiving) and understanding. The whole of nature can be summarized in the four concepts: substance, quality, quantity and movement. All numbers can be derived from the number four (Pythagoras' tetractys) and all geometry from four concepts: point, line, surface and body.[619]

Pauli observed that Fludd's philosophy was very archaic, but that it nevertheless tried to grasp the totality in a manner different from Kepler's. Kepler's universe was confirmed scientifically, it is true, and contained the typical features of what came to characterize Western thinking: differentiation of the parts, quantifiability and one-sidedness. In Fludd the unity between the observer and what is observed is still central and a lot of weight is attached to the qualitative characteristics of reality. One interesting detail is that Kepler

[619]The different geometrical forms have for Fludd, just as for the Pythagoreans, a hierarchical relationship with each other. The cube is identified with the dark, damp earth, with the primeval matter from which the world arose, and therefore has scarcely any form or light. Its regularity makes it the most stable of all geometrical forms and therefore the lowest on the scale. It is followed by the icosahedron – water – which because of its complexity (it consists of twenty equilateral triangles) is considered heavy and is therefore ranked second lowest. Air is represented by the octohedron (eight equilateral triangles) and comes between water and fire. Fire is highest in the hierarchy and is represented by the simplest and therefore lightest and brightest of all forms – the tetrahedron. For that reason it is not possible, according to Fludd, to give – as Kepler had done – different geometrical figures the same divine rank. Pauli, 'The Influence of Archetypal Ideas', *WPP*, 276.

states in his debate with Fludd that he bases his results on wholly empirical foundations, whereas in actual fact they follow largely from purely metaphysical assumptions – such as the assumption that the material world is a realization of pre-existing archetypal images. Fludd, with his speculative philosophy, tries on the other hand to substantiate his theses by scientific experimentation, for example with the aid of the 'weather glass'.[620]

It was therefore not from the 'victor's' perspective that Pauli was interested in this collision of two worldviews. He was not trying to demonstrate the superiority of Kepler's perspective. In Pauli's opinion we have in fact something to learn from Fludd. Science can only advance if we learn to combine both perspectives. Pauli considered the conflict between worldviews from two aspects. It may be seen as a classical conflict between two different scientific temperaments. However it can also be seen in the light of the special dynamics of the development of knowledge and consciousness, where something has always to be sacrificed in order for progress to be made.

As far as the difference in temperament is concerned, Pauli accepted Jung's typological model and believed that he could distinguish two types of scientist in particular: the thinking type and the feeling type. More precisely this means the combination of thinking and perceiving (sensation type) versus the combination of intuition and feeling. He also associated these types with the difference between a trinitarian and a quaternarian approach. Trinitarian thinking proposes rational models and excludes qualities, feelings, values and the irrational, while the quaternarian approach is based on a total and intuitive view in which all this is included. It was such a temperamental conflict that characterized the clash between Goethe and Newton, in which Newton was the 'trinitarian' thinker whereas Goethe may be described as a 'quaternarian'. Similarly Pauli considered that Plato, Kepler, Descartes and, in modern times, Einstein could be called trinitarian thinkers, while Pythagoras, Kant, Schopenhauer, Fludd and Bohr could be called quaternarian. This opposing pair also reflected Pauli's own situation, because he felt divided between his pragmatic scientific thinking and an intuitive feeling side. 'I myself am not only Kepler but also Fludd', said Pauli.[621]

To approach the conflict between Kepler and Fludd from the second perspective, as an example reflecting the growth of consciousness, we have to return to Jung's view of symbol formation and knowledge. Pauli seems to have fully adopted Jung's views in this respect. This view is based on the observation that man adapts to his surroundings by specialisation. Jung especially

[620] Ibid., 253–54.
[621] Pauli to Fierz, 19 Jan. 1953 [1507], *PLC IV/2*.

developed his thoughts on this within the framework of his typology. Adaptation requires a directed conscious function and such can only be developed if everything that is incompatible with that attitude is excluded. So most people develop a speciality that implies a one-sided position. The paradox is that in the long run this adaptive function leads to poorer adaptation, because in life one often encounters situations that call for a variety of approaches. When the old habitual attitude is no longer effective, a reorientation of the individual is called for. This is not an altogether simple process. The unconscious still contains all that has been passed over or sacrificed to give priority to the differentiated attitude. There are new possibilities of adaptation there, which can be developed, but initially during a new adaptation these archaic and undifferentiated sides appear uninviting and dangerous. When approaching the undeveloped sides of the psyche one becomes clumsy and out of control – like a child learning how to walk . It is therefore quite natural to feel a strong resistance to becoming involved with these sides and to cling to those where you feel superior and strong. But what appears repulsive and coarse contains the seeds of a new attitude and a renewal of life.[622]

This process may also be seen as taking place in cultural history. From an original totality, a particular perspective is given priority and is being refined, while others are abandoned and fall into oblivion. The self-regulating centre of totality, however, will sooner or later refuse to tolerate this one-sidedness – what is forgotten and excluded will demand its tribute by returning in a different guise, a 'spectre' clamouring for notice.[623] Pauli constructed this perspective from a combination of Jung's principle of compensation and Bohr's complementarity; every differentiation of consciousness implies at the same time that something has to be sacrificed, something that then returns in a different guise.[624] Pauli considered this a profitable historical approach, a method of looking at matters which he summarized in the epigram '*das noch Ältere ist immer das Neue*' – *the even older is always the new*. This approach tries to answer the question: What has Gone Where?[625]

Pauli developed Jung's perspective and imagined that in an earlier culture or branch of knowledge a unified and broader worldview had prevailed, at the expense of precision. As time has gone by, certain areas have been differentiated and become increasingly precise, while other things have fallen

[622] Jung, 'On Psychic Energy', *C.W.*8, §60 ff.

[623] Pauli deliberately uses the Norwegian word *gengangere* for this and refers to Ibsen's play of that name. Pauli to Fierz, 13 Oct. 1951 [1289], *PLC IV/I*, 389.

[624] Pauli to von Franz, 19 Nov. 1951 [1308], *PLC IV/1*. See also Werner Heisenberg, 'Wolfgang Paulis philosophische Auffassungen', *Schritte über Grenzen* (Munich, 1971), 48.

[625] 'Was ist wohin gekommen?', Pauli to von Franz, 22 Dec. 1951 [1328], *PLC IV/1*, 472.

away. In the case of Fludd versus Kepler precision and quantification were won, but the soul as a direct expression of the objective cosmic order was sacrificed. A certain distance was created between the cosmic and the human soul, which now resembled the cosmic or divine order. Direct insight into this order could no longer be gained by pure introspection, there needed to be a correspondence between outer observation and inner images. In our eyes maybe a marginal shift, but the beginning of a development that culminated in the total disregard of the soul in the eighteenth century.

Pauli did not believe in a perfectly linear accumulation of knowledge and progress – what is left by the wayside is often as important as what is processed. He always worked on the assumption that every increase in knowledge and consciousness has to be paid for by something falling into obscurity. He referred to the experience of quantum physics and in particular to the uncertainty relationship; one has to make a choice of perspective (measurement apparatus). The more precise the information desired concerning the position of the particle, the more uncertain will be the information concerning its kinetic energy. In quantum physics one has also to choose between the classical demand for objectivity and the demand for completeness. With the aid of the statistical method one 'sacrifices' information from the individual observation in favour of a coherent and statistically regular worldview.[626] On the basis of these insights into the nature of human cognition one may also study the history of ideas and science in a rewarding manner if one asks: 'What has Gone Where?'

To Pauli this whole complex of questions was connected with the development of science and the situation in quantum physics. During the seventeenth century the cosmic order was taken out of the hands of God and the church and became a matter for science. The laws of nature became deterministic and mechanical, God receded slowly into the background. The laws were taken from God, but he was allowed to retain the miracles as his speciality for a while longer. The miracle represents a unique intervention that breaks through an otherwise deterministic order. In this way there is a division into two spheres: nature becomes a soulless machine, while man refers to God with regard to questions such as free will and the unique moment of creation. There is a splitting of that unity which had previously existed when God was praised for both the ordered regularity and the miracles.

What we see here, says Pauli, is the first steps in a shift in our picture of the world; the old unified religious view of the world with its explanations

[626] Pauli to Jung, 12 Dec. 1950 [47P], *PJL*.

becomes inadequate and human interest is turned in another direction in search of satisfactory answers. Man's living interest, or 'soul', is captured by a new area, in which he now slowly builds up a new worldview, this time based on the processes of nature. This means that a part of the old view is torn off and further developed, whereas other parts are abandoned and 'sacrificed' on the altar of the new knowledge. The soul, free will and the unique are relegated to the fringes of the worldview, or banished to the marginal existence of the private sphere or else disappear altogether.

From this point of view quantum physics signifies a new situation, and it is once again worthwhile to discuss the issues of determinism and freedom. Indeed, it even seems as though the old term 'miracle' – an umbrella term actually only expressing our wonder and lack of understanding – has now become a matter for science. Acausal connections, statistical laws of nature and synchronicity are terms which indicate that natural science can no longer close its eyes to these phenomena. The miracle, which had been displaced from the worldview, has returned in a new guise. In a letter to Markus Fierz, Pauli states the real purpose of his work on Kepler. The conflict between Kepler and Fludd reflects problems that have arisen again in modern times, namely the conflict between specialist knowledge and a holistic view or between rational empirical thinking and intuitive feeling. This conflict demands a solution – a *coniunctio* – both in modern thinking and in the lives of specific individuals. Modern physics, especially the Copenhagen School, offers a small-scale model for such a reconciliation of opposites. How a reconciliation of opposites on a larger scale would look, i. e. one which not only reconciles wave and particle but also psyche and matter, is as yet enshrouded in darkness. It is a solution which lies far in the future and about which Pauli so far dare only dream.[627]

[627] Pauli to Fierz, Jan. 1953 [1507], enclosure, *PLC* IV/2.

Alchemy, Background Physics and Concept Formation

Pauli had been interested in the symbolism of alchemy ever since he had been confronted with his own dreams in the course of his analysis. Jung, for his part, had already come into contact with alchemy in 1914 through the works of Herbert Silberer. In 1928 this contact was renewed through his friend Richard Wilhelm, a sinologist who went to China as a missionary and was instead himself captured by China's millennia of culture and wisdom. In 1928 he sent Jung a Taoist treatise that he had translated, *The Secret of the Golden Flower*.[628] At this point Jung attached no great importance to the fact that the treatise was both an instruction in yoga exercises – i. e. meditation technique for the purpose of achieving a higher state of mind – and an alchemist treatise. Jung had previously read gnostic texts, but thought that the element of true spiritual experience was drowned in the speculative, overworked systems of ideas that he found there. Only after deeper reading of certain Latin texts did it strike him that the alchemic component, which he had previously been unable to understand, formed an essential key – indeed, even the missing link between the spontaneous unconscious products and the more systematically worked out gnostic metaphysics.[629] Jung developed his interest in alchemy over a longer period of time and it seems that he immersed himself seriously in the material at the end of the 1930s.[630] The more he studied the alchemic texts, the more he was struck by the similarity between the description of the symbolic chemical process in alchemy and the symbolic material which is spontaneously produced by individuals un-

[628] According to Wilhelm this text has been handed down orally until it was written down in the eighteenth century. Richard Wilhelm, 'Origin and Contents of the T'ai I Chin Hua Tsung Chih', *The Secret of the Golden Flower*, 3.

[629] C.G. Jung, 'Commentary on ›The Secret of the Golden Flower‹', *C.W.* 13, 3 f.

[630] This can be concluded from the study of the different revisions of Jung's earliest publications on alchemy. In the texts 'Commentary on ›The Secret of the Golden Flower‹' and 'A Study in the Process of Individuation' from 1929 and 1933 respectively, Jung focuses on the mandala symbolism and alchemic motives are only mentioned in passing. The same can actually be said of Jung's analysis of Pauli's dream material at the Eranos conference of 1935: the mandala motive is much more emphasized than the alchemical parallels. The text 'A Study in the Process of Individuation', which deals with the mandala pictures of a mature woman, was republished in 1950 very much enlarged, mainly with alchemic parallels. The second part of *Psychology and Alchemy*, 'The redemption motives in alchemy', published for the first time in the Eranos Yearbook of 1936 is almost unrecognisable when republished in 1944.

The alchemic stages[631]	
1. black	nigredo, melancholy, death, putrefaction, Saturn, lead, raven, toad.
1b. green	*viriditas*, copper, Venus, green lion. Occurs only seldom in its own right, is described as a disease of metal (verdigris) and disintegration (disease as a precondition for healing).
2. white	*albedo*, sublimation, the Moon, silver, washing, swan, queen.
2b. yellow	*citrinitas*, (seldom occurs in its own right) dawn, awakening, peacock's train, forewarns of the final stage.
3. red	*rubedo*, fixation, king, sun, lion, gold. The final stage and the precondition of the completion of the work which is the uniting of the holy pair (King and Queen) in chemic union. (*Coniunctio*)

der analysis. The rich symbolism of the alchemists recurred in the dreams of modern individuals who did not know the first thing about alchemic symbolism.

The basic idea in alchemy is that everything is a part of an evolutionary process that is striving to attain the highest form. Among metals gold is the highest form and all the other metals are in various preliminary stages of the gold stage. The 'maturing' of the metal can be accelerated by various refining methods and thus all metals can be transmuted into gold. There were of course alchemists whose first and only purpose was to try to produce gold by chemical means. At the same time, however, there existed a mystical school, which saw the transmutation process as a spiritual path to redemption, where the external experimentation – *laboratorium* – was directly connected to an inner process of maturing and a contemplative attitude – *oratorium*. *Aurum nostrum non est aurum vulgi* – our gold is no ordinary gold – as the *Rosarium philosophorum* states.[632] The alchemic process may be summarized as *solve et coagula* – dissolve and coagulate – in other words concepts corresponding to analysis and synthesis. The original state is assumed to be a situation in which opposing forces are in conflict with each other. The great work lies in the process of bringing these forces together in a unified harmony. First it is necessary to separate the original material into its constituents (*solutio*,

[631] Refers back to the four primary colours of Heraclitus: melanosis (blackening), leucosis (whitening), xanthosis (yellowing), iosis (reddening).

[632] In *Artis Auriferae* (Basle, 1593). The literal meaning is: our gold is not the gold of the multitude.

putrefactio). In this way chaos is caused, a *prima materia*, which is the precondition for *coniunctio*, the new synthesis. To succeed in this it is necessary to go through a process of three (sometimes seven) stages which make up a system of correspondences. Each is not only equated with a state of mind, but also associated with a colour, an activity, an animal, a heavenly body, a metal, a physical state, a social position and so on. The outcome of the work is something qualitatively new, a higher state, which is greater than the sum of its parts. The highest state has many names and is associated with an indestructible, eternal source of power with transformative qualities, for example *lapis* = the philosopher's stone, *infans solaris* = the sun child, *filius philosophorum* = the son of the philosophers, *aqua permanens* = the eternal water.[633]

This procedure of disintegration and reconstruction has its equivalent in purely experimental science and also in therapeutic work. To be able to produce new substances man must first separate the components of the original material. In the sphere of the psyche the analogy is in the dissociated personality which has arisen as a result of the conflict between irreconcilable tendencies. In the analysis the therapist must first analyse the actual state of the person, bringing the conflict into the open to make the person being analysed aware of these incompatible attitudes. By being brought to the conscious level these can be detached from the neurotic structure of complexes in which they are locked and thus the conditions can be created for a reconciliation of the opposites and a renewal of the whole psychic balance.[634]

When Jung sent Pauli his 1936 Eranos Conference lecture that deals with redemption motives in alchemy, Pauli wrote to Jung:[635]

> I would just like to say a brief word of thanks for sending me your treatise on alchemy. It was bound to be of great interest to me, both as a scientist and also in the light of my personal dream experiences. These have shown me that even the most modern physics also lends itself to the symbolic representation of psychic processes, even down to the last detail. Of course, nothing is further from the thoughts of modern man than the idea of penetrating the secrets of matter in this way, for he would actually rather use these symbols to penetrate the secrets of the soul, since it seems to him that, relatively speaking, less research has been done on the soul, and it is less familiar than matter.[636]

In this early comment on the significance of alchemy Pauli draws on his own experience, to which he was constantly to return. He had noticed that his

[633] There is no accepted order or hierarchy to the different stages. This is a kind of rough pattern which more or less agrees with the various systems. The stages are often repeated several times at different levels.

[634] Jung's whole book 'The Psychology of the Transference' (1946) deals with the parallels between alchemic symbolism and the analytic/therapeutic process. (*C.W.*16)

[635] Jung, 'Die Erlösungsvorstellungen in der Alchemie', *Eranos-Jahrbuch* 1936 (Zürich, 1937); cf.

The stages of alchemy portrayed[637]

The black phase (nigredo)

The white phase (albedo)

The trans-formation of the king

The red phase (rubdeo) *and the final phase* (Coniunctio) *together with the creation of lapis*

dreams contained concepts and images from physics, which were dealt with in a manner that indicates that they symbolized mental processes. In this connection he asked himself among other things why his dreams used the symbols and analogies of physics to describe psychic facts, and not images, taken from, for example, mythology. After numerous attempts at interpretation Pauli believed it improbable that these physical analogies could be interpreted on a subjective level.

Jung believed that the natural explanation for Pauli's dreaming in physical terms was that he was a physicist, on the principle *canis panem somniat, piscator pisces* – dogs dream of bread, fishermen of fish. But Pauli was not satisfied with this answer. Jung then suggested that these concepts, like rotating dipoles and others, are based on archetypal images that are projected onto non-visual matter and then turn up in dreams. However Pauli felt that there was more behind this than the mechanism of projection – particularly because he was convinced as a physicist that these concepts had something to do with the behaviour of real matter. He believed that the alchemic doctrine could illuminate the problem.

Might, for example, the dreams of a modern physicist, in which physical knowledge is treated in a very unscientific and symbolic manner, correspond to the symbolism in alchemy? Pauli took the example of the radioactive nucleus, which so often occurred in his dreams. There the nucleus was presented as something incredibly charged and numinous, which caused Pauli to assume that it represented a modern symbol of the *Self*, like the philosopher's stone with the alchemists. He thought that this symbol might have a collective significance, not merely a personal significance for himself.[638]

> But perhaps there is a lesson to be learned from alchemy's mistake of attributing to the lapis the ability to help in the manufacture of genuine gold. For it seems to me important for us, too, not to attach any particular expectations of external, material success to the occurence of the central symbol. This appears to be very closely connected with the 'epilogue' of your treatise, where you touch on the questions of ascribing psychic contents to the ego and the risk of the inflation of consciousness. Maybe the alchemists' idea that they could really make gold by using the lapis can be seen as an expression of such an inflation of consciousness.[639]

idem, *C.W.*12.

[636] Pauli to Jung, 24 May 1937 [22P], *PJL*, 19.

[637] This work of alchemy is reproduced on a scroll and attributed to the fifteenth-century monk George Ripley. Courtesy *Beinecke Rare Book & Manuscript Library*, Yale University.

[638] See, for example, Pauli to Kronig, 10 Mar. 1946 [807], *PLC III*, 345; Pauli, 'Background Physics', *PJL*, 179.

[639] Pauli to Jung, 24 May 1937 [22P], *PJL*. Translation altered by the author.

Pauli thought that we have something to learn from the mistakes of the alchemists – those who believed that gold could be created with the philosopher's stone. The mistake lies in attaching material hopes to what should instead symbolize man's striving for an inner value. As Pauli regarded the radioactive nucleus as a modern parallel to the *lapis* of the alchemists, one may wonder how he viewed contemporary research into the atomic nucleus. He says that one can see the alchemists' hopes of creating gold as an inflation of consciousness, in other words as a sign of human arrogance.

If one were to develop further this parallel drawn by Pauli, one might ask whether perhaps many modern physicists have unconsciously attached high expectations to the radioactive atomic nucleus. Could they have been driven by something which goes far beyond the concrete nucleus, by something like the *lapis* of the alchemists – i. e. by the dream of a substance which can give a never-failing force and a possibility of transforming everything into whatever one wants? In modern times, when physics has become totally separated from a contemplative consideration of the cosmos, one might be able to draw the parallel with the period when alchemy began to degenerate into gold-making and to lose its function as a route to individuation. The vulgar alchemists, with their hopes of creating gold with the aid of the philosopher's stone, are the counterpart to the physicists of modern times, with excessive hopes pinned on the radioactive nucleus. It would solve everything, just like *lapis*: give access to inexhaustible energy, create material prosperity and peace on earth. These exaggerated hopes again express a seeking for the *Self* in a concrete and vulgarized form. This is a sign, then as now, of the hubris of consciousness and it can finish only as foretold in the myth of Icarus – with Icarus' fatal dive into the sea.

Pauli became increasingly interested in the deeper significance of the 'misuse' of the terminology of physics in dreams. It touched on one of Pauli's abiding interests: what is the relationship between our concepts and images of reality and our direct perceptions? The Kepler essay begins with the question of the relationship between sensory impressions and conceptualization. Jung's psychology has given us the tools for a better understanding of this relationship. His concepts of archetype and symbol may add a new dimension to our epistemology.

> My starting point is the nature of the bridge between the sensory perceptions and the concepts. Admittedly logic cannot give or devise such a bridge. If the previously known stage of the concept is analysed, one always finds ideas which consist of 'symbolic'* images with a generally strong emotional content. The preliminary stage of thought is a *pictorial viewing* of these internal images, whose

> origin cannot be only or principally traced back to the sensory perceptions (of the individual concerned) but which are produced by an 'instinct of the imagination' and are reproduced independently, i. e. collectively, in different individuals. [–––]
>
> *Cf C.G. Jung's definition of *symbol* in his Psychological Types. The s[ymbol] expresses a 'postulated but as yet unknown objective fact'.[640]

If the preconscious stage of conceptualization is studied one always discovers images and notions of a symbolic character – in Jung's sense of the word. The preliminary stage of rational concept formation consists of a kind of visualization that cannot be reduced to individual sensory perceptions. This visualization must be attributed to a kind of representational instinct which is common to all people, as the symbols seem to be reproduced all over the world independently of each other. Even in modern man the step between rational consciousness and this preconscious level is not a long one. The slightest lowering of consciousness causes fantasies and archaic images to rise to the surface. If one is interested in gaining insight into the nature of scientific conceptualization, one must take account of this preliminary stage. Pauli came to call this area of study the 'psychology of scientific conceptualization'.[641]

Pauli declared that the 'misuse' of the terminology of physics in dreams is 'a kind of free association in analogies which can probably be seen as a preliminary stage of conceptual thinking'. Pauli even tried to compile a kind of 'translator's glossary' which would show how on a symbolic level these physical terms express psychological processes.[642] The attempt to do this dates as far back as 1935, when in a letter to Jung he mentions the splitting of the isotope as symbolizing the cessation of *participation mystique** by individual differentiation, the radioactive nucleus as a symbol of the *Self* and the resonance points as symbols of the archetypes, especially of the psychic state which is characterized by an identification with the archetype. The radioactive nucleus is in many ways an apt symbol of the Self: the words *individual* (individus) and *atom* both mean the indivisible, in other words they stand for wholeness. Furthermore the radioactive nucleus has on account of its radiation a strongly transformative effect on everything around it. This may be compared with Jung's description of how a person who has achieved self-knowledge, in other words some kind of integration, balance and wholeness,

[640] Pauli to Fierz, 7 Jan. 1948 [929], *PLC III*, 496.

[641] Pauli to Fierz, 7 Jan. 1948 [929], *PLC III*, 496; Pauli to Jung, 12 Dec. 1950 [47P], *PJL*, 65 (The English translation has 'psychology of the scientific formation of concepts'.

[642] Pauli to Jung, 22 Jun. 1935 [9P]; 4 Jul. 1935 [11P]; 2 Oct. 1935 [13P], *PJL*.

* Jung borrowed this term from Lucien Lévy-Bruhl and understood it as the feeling of being bound and identified with something outside oneself, i. e. the inability to differentiate between one's own qualities and somebody else's.

has an involuntarily positive effect on his surroundings.[643] Concerning the resonance points, Pauli says that every engineer knows the disastrous results when two frequencies coincide, whereas the man in the street does not know that one can escape the resonance by raising the frequency.[644] This may be compared symbolically with what Jung has said about the catastrophic consequences of an individual's identifying with an archetype, in other words losing his individual viewpoint. However one can free oneself from this identification by increasing one's consciousness.[645]

Pauli could not let go of this subject, and asked again and again: 'Why do I dream in the terminology of physics?' In June 1948 he returns to the subject in a manuscript called *Moderne Beispiele zur 'Hintergrunds-physik'* (Modern Examples of Background Physics).[646] By *background physics* Pauli meant 'the appearance of quantitative terms and concepts from physics in spontaneous fantasies in a qualitative and figurative – i. e. symbolic – sense.'[647] Pauli first tried to interpret this misuse of physics terms as a peculiarity of his dreams alone. Later he discovered the same symbolic use of concepts in two other contexts. It occurred, for example, among scientifically untrained or uncritical individuals who, on the basis of a kind of analogical thinking, use the terminology of physics to describe quite different phenomena. This was the case with Jung and the Jungians who thought about physics in a way that Pauli dreamt about it.[648] Pauli also recognized this way of dealing with concepts from the physics treatises of the eighteenth century, when the scientific vocabulary was not yet developed and physical reflections were mixed with symbolic representations. Pauli had become aware of this in his reading of Kepler. He therefore assumed that what he called *background physics* was a kind of archetypal imagining. From a contemporary scientific viewpoint this form of imagination has to be regarded as a reversion to an archaic stage. To Pauli, however, it was more important to emphasize that a purely psychological interpretation of these fantasy products can only cover half of the objective situation – the other half involves *a factual exposure of the archetypal basis of the physical concepts applied today*.

If this were indeed the case, i. e. if the symbolic use of scientific concepts revealed something about a deeper structure of reality underlying both

[643] C.G.Jung, 'The Undiscovered Self' (1957), *C.W.*10, §583.
[644] Pauli to Jung, 2 Oct. 1935 [13P], *PJL*.
[645] Jung, 'The Relations Between the Ego and the Unconscious', *C.W.*7, §389 ff.
[646] Markus Fierz writes in Appendix 2 to *PJB* that the essay must have been written in 1950. This is clearly incorrect because in several of his letters Pauli himself refers to his essay 'Background Physics' from 1948. Ibid., 173. See, for example, Pauli to Jung, 28 Jun. 1949 [37P],*PJL*.
[647] Pauli, 'Background Physics', *PJL*, 179.
[648] Pauli to Fierz, 26. Nov. 1949 [1058], *PLC III*, 708.

psyche and matter, this would indicate the possibility of a future unified psychophysical description of nature. Pauli thus believed that the production of background physics in his dreams gives a glimpse into the true archetypical foundation of the cosmos, but our present knowledge situation is still at a prescientific stage in this respect. The possibility of a description of nature that embraces both our psychological and physical reality, without one being reduced to the other, requires a return to the archetypal background of our scientific concepts. This leads the physicist inexorably into the field of psychology. But, says Pauli: 'As I regard physics and psychology as complementary types of examination, I am certain that there is an equally valid way, which must lead the psychologist ›from behind‹ (namely, through investigating the archetypes) into the world of physics.'[649]

Another frequently occurring motif in Pauli's dreams is the theme of the *fine structure*, particularly the doublet structure of spectral lines and the splitting of chemical elements into two isotopes. The dream motif consists in an authority in the field appearing and saying that the splitting of a spectral line into doublets or the splitting of a chemical element into two isotopes is of the greatest importance. Sometimes the authority adds that Pauli must carry out this procedure or that he has just succeeded in doing so. Sometimes he sees the spectral line clearly and its splitting as if in a spectroscope. Pauli considers it important for the result of the split, the two components, to be of equal strength. In order to get at the deeper meaning of the symbolism of the theme, one has to translate it into a *neutral* language.

Pauli links his idea of a neutral language to the symbolic language of the alchemists, but it is easy to recognize the parallel with Ernst Mach's and other positivists' search for a unified scientific language. Pauli did not share the belief of the Vienna Circle that logic could be such a unifying language. Instead he turned his hope in the direction completely opposite to logic: the obscure and ambiguous language of the alchemist, a language that unites concepts of material substances and processes with mental ones. The term *Mercurius* is the name of both the material substance quicksilver, and man's spiritual capacity for transformation. In the same way the term sublimation describes both a chemical transformation process and the transformation of lower drives into a higher state of consciousness. In alchemy we therefore find a psychophysically unified worldview with an accompanying integrated – psychophysically neutral – language. Pauli considered that the latest developments in physics and psychology showed that it might be time to take up

[649] Pauli, 'Background Physics', *PJL*, 180.

the hypothesis of the neutral language again, as both of these disciplines had begun independently to employ similar concepts. The discovery of alchemy and its symbolic language had been of great importance to Jung's psychology, as a result Jung had been obliged to confront matter and natural science. Pauli asked if modern science would now 'be able to realize, on a higher plane, alchemy's old dream of a psycho-physical unity, by the creation of a unified conceptual foundation for the scientific comprehension of the physical as well as the psychical?'[650]

The hypothesis of the neutral language is based on Pauli's opinion that the ordering factors which Jung calls archetypes are neither in the psyche nor in matter but beyond both, on 'neutral ground'. As these 'neutral' factors shape both psyche and matter, it ought to be possible to formulate the functions of these principles in a neutral language, which is valid for both psyche and matter. One might call this language *the language of nature*.[651] A neutral description may be produced if one tries to describe the symbol in as abstract a manner as possible, by bringing out its structure. The following may for example be stated about the notion of 'frequency': on the one hand it defines a specific energetic state, on the other hand it constitutes, considered temporally, a regular repetition. A chemical element may be described as an object which is recognized by its specific reaction, but it also has a mass aspect, which makes division possible.

According to these principles Pauli makes an attempt at a translation of his dream images: the important thing is to split a specific energetic state or object – recognizable by its specific reactions – into two parts which display related, but nevertheless different, reactions. This separation cannot be carried out by passive contemplation but must be implemented by means of a refined conscious method of observation. Such a 'neutral' description applies equally well if the object is a physical state or a psychic content. Both require an artificially designed technique in order to attain their result. In the one case a technical apparatus is involved, in the other a psychological working method, for example active imagination. From the perspective of the unconscious it is the same sort of procedure. Pauli associates the division with a 'birth' of something new and with the suspension of naive psychic identity (*participation mystique*), and hence with an increase of consciousness. He compares this to Jung's observation that a dream motif, which occurs in duplicated form, is an indication that there is a content just beneath the threshold of consciousness that will soon become conscious. The symbolism

[650] Pauli, 'Science and Western Thought', *WPP*, 146.
[651] Pauli to Fierz, 21 Aug. 1948 [971], *PLC III*, 561.

is linked to the motif of *reflection* that occurs in many creation myths and which is also expressed in the motif of the two hostile brothers, of whom one is spiritual and the other earthbound. The myth expresses the idea that every content of consciousness has a mirror image in the unconscious that possesses totally different and 'non-realized' features.

Pauli sees a profound correspondence between certain physical and psychic states of affairs, particularly in certain complementary opposing pairs. He proposes the following scheme:[652]

Pauli's comparison of subject and object in physics and psychology

	Physics	Psychology
Object	indestructible energy and momentum	timeless objective-psyche
Subject	definite space-time process	ego consciousness-time

Pauli states that it is difficult to determine what reflects what. From the psychologist's point of view these abstract physical principles are projections of psychic mechanisms onto matter. But, seen from outside, the microphysical processes may just as well be regarded as archetypal in themselves, being reflected in the psyche in order to make knowledge possible. What is important is to accept – in a genuine spirit of complementarity – that the apparently contradictory aspects of reality are reconcilable. This can only be done with the aid of reconciling symbols. In physics, the abstract mathematical functions fulfil this role. These can combine the apparent contradictions that appear in our visualization of reality.

Pauli's vision is a unified worldview, in which the gap between psychological and physical worlds is suspended, just as the gap between the chemical and the physical has been suspended at the atomic level. The idea is that the closer one gets to the core of things, to their intrinsic structure, the more the differences perceived on the everyday macro level are suspended. Here we recognize again the positivistic wish to create a unitary science. The important difference is, however, that Pauli did not want to see a reductionist model, in which everything can be reduced to an existing science, like logic or physics. He sought rather a wholly new scientific approach which does not disregard the unique character of the individual sciences, but which attempts to find certain common denominators – a deep level based on the belief in certain universal structural elements which reveal themselves in all areas of experience.

[652] Pauli, 'Background Physics', *PJL* 191.

Pauli's reply to the question of the unifying link between our sensory impressions and our concepts is thus the assumption of an objective order in the cosmos, an order which structures not only matter but also our psyche and therefore our conceptions. These structures are of a highly abstract nature, non-visual and impossible to reproduce exactly in any 'language' known by us. On the other hand these underlying structures *find expression* in many different linguistic forms, for example in artistic, theological, psychological and physical language. An indication that one is approaching these structures is that one is obliged to make use of abstract, multifarious symbols and paradoxes. Mathematics might be the language that comes closest to these structures. The idea is therefore that the underlying structures are universal, and common to all kind of realities: physical, spiritual, psychological and so on. But they (the archetypes) express themselves in a heterogeneous phenomenology. In the world of everyday physics – on the macro plane – and in our everyday consciousness, every phenomenon occurs with its specific characteristics. The opposites are apparent and the multiplicity requires mutually exclusive images and languages in order to do justice to the unique qualities of the phenomena. On this visible plane, laws and forms apply which are subject to time and space, culture and social structure. Here wave and particle appear, conscious and unconscious, science and religion, spirit and matter, as irreconcilable opposites. However if one penetrates beyond the multiplicity, one comes closer to increasingly universal structures, primarily those which can summarize all physical phenomena and those which can summarize all psychic phenomena – and ultimately structures which apply to both areas.

Pauli visualized the actual cognitive process as an interaction between psychic structures (concepts and representations) and physical structures (observations of external objects and their relationships). Representations are projected onto reality, but corrected by empirical data, which leads to the creation of a new image. The inner image is in turn formed on the basis of certain non-visual symmetrical and structural elements (archetypes) which are also active in the material world. It is when these two, the internal and the external image, come into congruence (zur Deckung kommen), that knowledge arises. Both psyche and matter find certain typical and recognizable forms of expression that seem to rest on non-visual general structural factors beyond the division of matter and psyche. The actual acquisition of new knowledge, in other words the experience of sudden recognition in the cognitive process, might in such cases mean that our internal images overlap or match the ex-

ternal objects and their structures.[653] This might explain how purely mental constructions (such as Einstein's theory of relativity) can predict how matter will behave.

> In contrast to the purely empirical conception according to which natural laws can, with virtual certainty, be derived from the material of experience alone, many physicists have recently emphasized anew the fact that intuition and the direction of attention play a considerable role in the development of the concepts and ideas, generally far transcending mere experience, that are necessary for the erection of a system of natural laws (that is, a scientific theory). From the standpoint of this not purely empirical conception, which we also accept, there arises the question of the nature of the bridge between the sense perceptions and the concepts. It seems most satisfactory to introduce at this point the postulate of a cosmic order independent of our choice and distinct from the world of phenomena. Whether one speaks of the 'participation of natural things in ideas' or of a 'behaviour of metaphysical things – those, that is, which are in themselves real,' the relation between sense perception and idea remains predicated upon the fact that both the soul of the perceiver and that which is recognized by perception are subject to an order thought to be objective. Every partial recognition of this order in nature leads to the formulation of statements that, on the one hand, concern the world of phenomena and, on the other, transcend it by the 'idealized' use of general logical concepts. The process of understanding nature as well as the happiness that man feels in understanding – that is, in the conscious realization of new knowledge – seems thus to be based on a correspondence, a 'matching' of inner images preexistent in the human psyche with external objects and their behavior.[654]

Physics and its laws can cover only a part of our experienceable reality. The laws of physics can only describe closed sub-systems in a greater reality, which is open in character. Therefore physics has to be regarded as incomplete, but in a sense directly opposite to that meant by Einstein.[655] Einstein considered quantum physics incomplete because it does not present a uniform physical worldview that does not depend on the way in which it is measured – a fact that he considered particularly unacceptable. Pauli, on the other hand, considered physics incomplete in relation to life as a whole. It is able only to deal with closed, reproducible sub-systems – it excludes everything else which concerns human reality such as feelings and values – in brief, all psychological reality. Because of its statistical character it also excludes everything individual and unique.

> According to its own definition, physics has to conceptualize *regularity* in nature and thus has to focus its attention only towards the *reproducible* and quantitatively measurable. As a consequence of this limitation that is at the very essence of

[653] Pauli, 'The Influence of Archetypal Ideas', *WPP*, 221.

[654] Idem, 'Two lectures by Pauli at the Psychological Club of Zürich' (28 February and 6 March 1948), [Appendix 6], *PJL*, 203.

[655] Cf Einstein to Besso, 8 Aug. 1938, [157] (E.79), *Correspondance*, 403.

> physics, anything that is feeling toned, judgmental, and emotional remain outside it on the opposite psychological side. What is more, from this root there also springs the *statistical character* of its statements, which, especially with atomic processes, means basically dispensing with the recording of individual cases (apart from special ones). This is not a question of any incompleteness of the quantum theory within physics[15] but a incompleteness of physics within life as a whole.
>
> [15] Some older physicists hold this point of view, but the majority, including myself, do not accept it.[656]

Several of the subjects Pauli touches on in his essay on background physics are taken up again and developed on later occasions. Naturally Pauli himself regarded this essay as extremely speculative, although a start, a first attempt, to bring psychic and physical reality together and to find a unified, symmetrical worldview. In 1953 Pauli sends Jung a table showing the parallels he thinks he has found between physics and psychology:

> I cannot anticipate the new coniunctio, the new hieros gamos called for by this situation, but I will nevertheless try to explain more clearly what I meant with the final part of my Kepler essay: the firm grip on the 'tail' – that is, physics – provides me with unhoped for aids, which can be utilized with more important undertakings as well, to 'grasp the head.' It actually seems to me that in the *complementarity of physics*, with its resolution of the wave-particle opposites, there is a sort of *role model or example of that other, more comprehensive coniunctio*.[...] For the smaller coniunctio in the context of physics, completely unintentionally on the part of its discoverers, has certain characteristics that can also probably be used to resolve the other pairs of opposites listed on p. 3.[657]

[656] Pauli, 'Background Physics', *PLJ*, 196. Translation altered by the author.
[657] Pauli to Jung, 27 Feb. 1953 [58P], *PJL*, 91–92.

He found the following analogies:

Pauli's comparison of quantum physics and Jung's depth psychology[658]

Quantum physics	*Psychology of the individuation process and the unconscious in general*
Mutually exclusive complementary experimental set-ups, to measure position as well as momentum.	Scientific thinking – intuitive feeling.
Impossibility of subdividing the experimental set-up without basically changing the phenomenon.	Wholeness of man consisting of consciousness and unconsciousness.
Unpredictable intervention with every *observation*.	Change in the conscious and the unconscious when consciousness is acquired, especially in the process of the coniunctio.
The result of the observation is an irrational actuality of the unique occurrence.	The result of the coniunctio is the *infans solaris*, individuation.
The new theory is the objective, rational and hence symbolic grasping of the *possibilities* of natural occurrences, a sufficiently broad framework to accommodate the irrational actuality of the unique occurrence.	The objective, rational, and hence symbolic grasping of the psychology of the individuation process, broad enough to accommodate the irrational actuality of the unique individual.
One of the means used to back up the theory is an abstract mathematical sign ψ, and also complex figures (functions) as a function of space (or of even more variability) and of time.	The aid and means of backing up the theory is the concept of the unconscious. It must not be forgotten that the 'unconscious' *is our symbolic sign for the potential occurrences in the conscious*, not unlike that ψ.
The laws of nature to be applied are statistical laws of probability. An essential component of the concept of probability is the motif of 'the One and the Many.'	There is a generalization of the natural law through the idea of a self-reproducing 'gestalt'[659] in the psychic or psychophysical occurrences, also called 'archetype.' The structure of the occurrences that thus come into being can be described as 'automorphism'. Psychologically speaking, it is 'behind' the time concept.
The atom, consisting of nucleus and shell.	The human personality, consisting of 'nucleus' (or Self) and 'Ego.'

[658] Ibid.

[659] The English translation says 'figure'; I prefer the word 'gestalt'. Ibid.

Spirit, Nature and Archetype

In 1946 Jung extended his concept of the archetype. The first time he presented his expanded view was in his Eranos lecture *Der Geist der Psychologie* [The Spirit of Psychology] in that year. There he emphasized and developed the difference which he had already stressed in 1938 between 'the archetype in itself' and its manifestation in the form of archetypal images, conceptions and actions. In 1938 he argued that the archetype is not determined in content but only, to a certain extent, in *form*. The archetypes are therefore not 'unconscious images or conceptions' but a sort of structural element which functions like the axial system in a crystal, which so to speak preforms the crystal formation in the mother liquid without having a material existence of its own. The archetype is described as an empty, formal element, or as an a priori *possibility* of representational form. What is inherited in man is not the representation or the image but potentials for formal structures that correspond to the formally determined instincts. There are additional parallels between crystal formation and archetype as the axial system determines only the stereometrical structure and not the concrete shape of the individual crystal. The crystal may display endless variations; what is constant is only the invariable relative geometrical conditions of the axial system. The same applies to the archetype, which has an invariable core of meaning, while its individual expression can only be confirmed when it has been 'filled out' with experiential material from the conscious sphere, i. e. with material conditioned by culture and environment (Jung called this the collective consciousness).[660]

In 1919 Jung had largely equated 'the primordial image' with 'the dominants of the unconscious' and 'the archetype'.[661] In 1927 he emphasized that the archetype is not to be seen as something static but much more as a dynamic and creative 'system of aptitudes'.[662] Despite certain resemblances to the Platonic ideas, Jung's archetypes differ from these at many essential points. In Plato, the ideas are linked to the light, the Good, the clear and the

[660] Idem, 'Psychologische Aspekte des Muttararchetypus', *Eranos-Jahrbuch* 1938, Zürich, 1939), 409 f. Cf idem, 'Psychological Aspects of the Mother Archetype', *C.W.9I*, §155.

[661] Idem, 'Instinct and the Unconscious', *Contributions*, 280. (Cf *C.W.*8, §277).

[662] Idem, 'The Structure of the Psyche', *C.W.*8, §339. Cf idem, 'Die Erdbedingtheit der Psyche', *Der Leuchter*, Buch 8, Ed. Herman Keyserling (Darmstadt, 1927), 106.

rational. In contrast Jung describes the archetype as bipolar, irrational and beyond good and evil. The archetype theory is not a 'recollection theory' in Plato's sense and does not guarantee moral order.[663] The archetypes are in no way inherited ideas, they are inherited *potential structures which express themselves in compulsive necessities*. They represent something that *befalls* man as a living, autonomous force, constantly expressing themselves in a new phenomenology.[664] Jung stressed that it is the task of consciousness to relate to the archetypes and to the unconscious. He presents this as possibly man's greatest ethical duty. His own opinion is in sharp contrast with those who claim that Jung means that the archetypes are something 'one should follow' or 'identify' with.[665] This also goes against the claim that Jung's archetypes are a 'Kantian' concept. Kant's categories are the categories of reason, moulding our perception of the world. True, archetypes mould our perception in an unconscious and often compulsive way, according to Jung, but the faculties of consciousness and reason are not slaves to the archetypes. On the contrary, consciousness is our only hope of getting out of the maze of archetypal projections. In a document dating from as early as 1916 Jung states that the most important task of man is to achieve individuality, and that this involves overcoming the tendency to self-idolization that arises when one is confronted with the collective unconscious and its archetypes.[666] Jung expresses this even more clearly in 1928, when he says:

> One can only alter one's attitude and thus save oneself from naively falling into an archetype and being forced to act a part at the expense of one's humanity. Possession by an archetype turns a man into a flat collective figure, a mask behind which he can no longer develop as a human being, but becomes increasingly stunted.[667]

This risk of being transformed into an 'inhuman, one-dimensional figure' is particularly imminent among therapists and doctors, especially those who come into contact with people's unconscious needs and expectations. People in these professions may, because of the strong transference situation, easily lose their touch with reality and their human proportions; they hide behind their professional role and are transformed into experts, gurus and sectarians.[668] The archetypes and the unconscious represent real forces that one

[663] This is asserted in, for example, Nagy, 45.

[664] Jung, 'Analytical Psychology and Weltanschauung', *Contributions*, 157. Cf *C.W.*8, §718.

[665] Cf for example, Steen Visholm, 'Myter och psykologien kritik av Jungs psykologi', *Res Publica* 21 (1992), 141–42; Noll, 255.

[666] Noll, 251.

[667] Jung, 'The Relations Between the Ego and the Unconscious', *C.W.*7, §390. Cf idem, *Die Beziehungen*, 195–196.

[668] Idem, 'The Tavistock Lectures', *C.W.*18, §353–54.

must take into account, they are internal compulsive powers that are often in conflict with the conscious and the collective norms. One finds oneself in a moral dilemma and it requires real work, a true *Auseinandersetzung*, to resolve the conflict and arrive at a new position.[669] Only by consciously taking a position with regard to the archetypes as natural forces does man become ethical.[670] It was this non-Platonic view of the archetype that Pauli could embrace – the archetypes as non-static categories of representation and systems of aptitudes that always stand in a dialectical relationship to the conscious viewpoint.[671]

At an early stage Jung drew a comparison between archetype and instinct. Instinct is defined as typical, regularly recurring *ways of acting*, whereas the archetype is defined as typical, regularly recurring *ways of apprehension*. In this way the archetype is construed as corresponding to the instinct, indeed even as the instinct's perception of itself, or the 'self-portrait' of the instinct. Together the instincts and the archetypes form the collective unconscious.[672] In the earliest definition from 1919 the archetypes are, as it were, on the 'spiritual' side, the archetypes constitute our mental activities, whereas the instincts constitutes the physiological activity. By 1927 the concepts of instinct and archetype have drawn closer together, the archetype is nothing other than the *form* the instincts assume. Jung identifies the unconscious with nature itself and the archetypes with a kind of natural force. The human psyche is a piece of nature, which, like nature, conservatively confines itself to the same successful forms, but which simultaneously suspends its determinism in constant new acts of creation.

> From the living fountain of instinct flows everything that is creative; hence the unconscious is not merely conditioned by history, but is the very source of the creative impulse. It is like Nature itself – prodigiously conservative, and yet transcending her own historical conditions in her acts of creation.[673]

In his 1946 essay Jung tries to make his position clear. Here he emphasizes the importance of the organic substrate to the mental functions and states that the psyche is incorporated in the life of the organism. But that does not make it necessary to believe that the psyche can be reduced to its physiological

[669] Idem, 'On the Nature of the Psyche', *C.W.*8, §410.
[670] Idem, 'A Psychological View of Conscience' (1958), *C.W.*10, §845.
[671] Pauli, 'Science and Western Thought', 142.
[672] Jung, 'Instinct and the Unconscious', *C.W.*8, §273–281. The original text of 1919 states: 'The image might be suitably understood as intuition of the instinct in itself, analogous to the conception of consciousness as an internal image of our objective vital processes.' *Contributions*, 280. The formulation 'the instinct's self-portrait' (Selbstabbildiung, self-portrait) probably dates from 1948.
[673] Idem, 'The Structure of the Psyche', *C.W.*8, §339. Cf 'Die Erdbedingtheit der Psyche', 106.

chemistry. Such a reductionist model does not take into account the fact that life seems to be the only factor which can convert statistical organizations that are subject to the laws of nature into higher 'unnatural' states in opposition to the law of entropy of inorganic nature.[674]

The relationship between archetype and instinct may be illuminated by studies of genuine spiritual experiences. They are often as compulsively overwhelming in their nature as the manifestations of the bodily instincts. Despite this, archetype and instinct have always been seen as the most diametrical opposites. Nevertheless they belong together as corresponding states. They exist side by side as a reflection of the opposites that underlie all psychic energy. Jung thus imagines the psychic process as a true *'complexio oppositorum'* and plays with the image of a scale which stretches from instinct to archetype, on which consciousness 'slides'. The instinct may be compared with the infrared part of a colour spectrum, whereas the archetype is compared with the ultraviolet part. When consciousness is in the vicinity of the infrared part it is controlled by instinct; close to the ultraviolet, on the other hand, it is dominated by the spirit. This may also be described as two different sides of the instinct itself.[675] Instinct and archetype almost become synonymous to Jung. Instinct may be called a latent archetype which manifests itself on a longer wavelength and the archetype may be called instinct raised to a higher frequency. Although one cannot give one side primacy over the other or reduce one to the other, nevertheless the scale comes down on the side of the archetype. For we can never reach insight into and assimilate an instinct on the infrared biological level. We can only relate to the instinct when it is portrayed in another form – in image, ritual or imagination. Conscious processing and assimilation can only take place by means of an integration of the instinct as an image which both signifies it and at the same time brings it to life.[676]

In the same essay Jung states that we cannot know anything of the innermost nature of the archetype. One must differentiate between the archetype

[674] Idem, 'On the Nature of the Psyche', ibid., §375. Pauli strongly opposed Jung's formulation that the psyche might violate the law of entropy. No such thing needs to be assumed at all, because the law of entropy permits and promotes the possibility of a transition from disordered to ordered states in a partial system, if a compensatory increase in entropy occurs outside the system. This is, for example, the case in organic life processes where the metabolic processes are enough to guarantee the compatibility of the total entropy balance with the increase in the overall entropy required by the second law of thermodynamics. To Pauli the law of conservation of energy was one of the most important, if not the most important, of all physical laws and could not be questioned. Pauli, 'Background Physics', 191, footnote 9.

[675] Jung, 'On the Nature of the Psyche', *C.W.*8, §414.

[676] Ibid., §406 ff.

in itself and its forms of manifestation.[677] It must be remembered that the true nature of the archetype is non-visual, it transcends our categories and should not therefore be called 'psychic' but *psychoid* – that is to say *quasi*-psychic. It is manifested in a psychic form, but is of an unknown nature.[678] The visual or concrete manifestation of the archetype, the actual variation on the basic theme, is a psychic product, but it says nothing about the innermost nature of the basic theme. Despite this assertion, Jung argues that we have no alternative but to regard the archetype as *spirit*. The argument then concludes with Jung maintaining that the true nature of what we call 'spirit' and 'matter' is unknown to us.

Such formulations caused Pauli to prick his ears up. Pauli was very anxious that Jung should not express himself carelessly with regard to this essential question. One cannot state that it is impossible to know anything about the innermost nature of the archetype and at the same time describe it with epithets such as 'spirit' or 'psyche'. The same applies to the concept of the unconscious. Pauli decided to raise the matter with Jung in an exchange of letters in the spring of 1953.

[677] Ibid., §417.

[678] Jung had taken the term psychoid from Hans Driesch and Eugen Bleuler, but did not use it in the same way as they did. Ibid, §368 f.

Jung as Positivist

In January 1953 Pauli returned from a two-month visit to India.[679] He had been obliged to return home earlier than planned because his wife had fallen ill under the effect of the Indian climate. Pauli, on the other hand, felt invigorated and revitalized by his stay in India. Pauli writes to Fierz that India – for better or worse – brings opposing pairs to life.[680] So, too, with himself. He spoke of India's *homeopathic* effect, which for his part raised all the old questions that demanded a formulation. He wrote several long letters to Fierz on the opposing pairs within himself: Kepler and Fludd, Protestantism and Catholicism, physics and psychology, scientific thinking and intuitive feeling, and the possibility of reconciling them. To Aniela Jaffé he wrote: 'I must write, write, write…'[681] This creative phase also resulted in Pauli's composing an 18-page letter to Jung. The treatise was adorned by the legend *'To be' or 'not to be', this is the question.*[682]

Here he discusses the difference between old and new physics from an epistemological perspective. Modern physics has come into conflict with the old ontology that states that physics is a description of *the real*. It is no longer possible to make a simple division between 'being' and 'non-being' and to check it by experimental set-ups. Pauli thought that modern physics once again faced questions of 'being' and 'non-being' which had characterized the debates of antiquity. The conflict between Einstein and Bohr may thus also be seen as a conflict between Parmenides and Heraclitus. The solution to the conflict between 'being' and 'non-being' is to proceed from the point where Aristotle stopped. In Aristotle's concept of *potentiality* being is not placed in a metaphysical location beyond human experience, in 'the Absolute' or 'Heavens'. Instead the idea (or form) is uni-

[679] Pauli had for several years a standing invitation from his former pupil and friend Homi Bhabha to come and visit the newly installed *Tata Institute of Fundamental Research*. Wolfgang and Franca Pauli left on 9 November 1952 and planned to return in March 1953. Pauli became fascinated by the culture, philosophy and religion of India. He also made the acquaintance of the Indian scholar Sarvepalli Radhakrishnan (1888–1975) whose philosophy he acquired and appreciated in some aspects and rejected in others. He especially rejected the tendency to 'over-spiritualization' and the hostility to matter. See *PLC IV/2*,XXVII and Pauli to Panofsky, 7 May 1953 [1570], *PLC IV/2*.

[680] Pauli to Fierz, 16 Jan. 1953 [1505], *PLC IV/2*.

[681] Pauli to Jaffé, 12 Feb. 1953 [1518], *PLC IV/2*.

[682] Pauli to Jung, 27 Feb. 1953 [58P], *PJL*.

fied with matter and shapes our experience of a dynamic and changing world.

Pauli thought that the concept 'potential being' forms a suitable new description for the unconscious. The unconscious as an epistemological concept is of course a paradox. From a logical point of view the unconscious is a meaningless term. We are by definition unable to know anything about it, because it is beyond consciousness. Nevertheless the unconscious is an empirical reality that can be measured. From this point of view the unconscious is both 'non-being' and 'being'. With our concrete thinking we are in addition inclined to give 'the unconscious' a place, such as, for example, 'below' the conscious. Alternatively we wish to ascribe to it a substance, such as 'sexuality'. Even so, the unconscious is a boundary term, which defines the horizon of our field of vision, but also allows new things to crop up for our inspection. Pauli therefore felt that the unconscious could be described as 'potential being', particularly in view of Jung's definition of the archetypes as 'formal possibilities'. Pauli wants to place the concept of the unconscious in the same 'symbolic reality' as the electrons or atoms in physics: both wave and particle are 'potential being', while one of them is always 'actual non-being'. The wave function (ψ) represents a measure of the probability of finding a topical particle. In the same way the theory of the unconscious and its archetypes represents a map of the possible processes of consciousness.[683]

Jung replies to Pauli's letter that he would prefer to avoid the term 'being' altogether. He notes that those who use the term 'non-being' always really mean *a different understanding of being*, as for example in the case of the Nirvana concept.[684] Rather than get involved in various metaphysical speculations on 'being' he wishes to use the concepts 'ascertainable' and 'unascertainable'. These concepts link 'the actual' and 'the non-actual' to the indispensable observer. If one speaks of *Being*, and moves onto the ontological level, one immediately comes up against the question of what existence ultimately consists of – materialism and idealism form such metaphysical viewpoints. 'Matter' and 'spirit' may only be used as labels for categories of ideas, in other words to indicate what we perceive to be the origin of a particular experience. Physics can therefore be described as the 'science of physically labelled ideas (*Vorstellungen*)'. It is through the psyche of the observer that all experiences pass, irrespective of whether they are perceived to be of a material or a spiritual character. Basing one's judgement of reality on ideas of the nature of Being always involves putting a part of the psyche

[683] Jung, 'Psychology and Religion', *C.W.*11, §165.
[684] Jung to Pauli, 7 Mar. 1953 [59J], *PJL*.

'outside'. This is a relic of the primitive *participation mystique* and forms an obstacle to the attainment of individual consciousness. Moreover it leads to a one-sided 'spiritualization' or 'materialization' of existence – the psyche is reduced either to a 'place above the clouds' or to a glandular function. Instead the psyche must be seen as the third medium – Plato's *τριτον ειδοζ (triton eidos)* – the point of intersection where human experience is formed. Man's experience is always a combination of spiritual (ideological) and material (physiological) experiences.

When Pauli reads this letter, it awakens old memories in him – the memories rise from a silver goblet in *Jugendstil* that radiates the calm, indulgent and cheerful spirit from days of yore.[685] This spirit takes the form of Ernst Mach and the goblet is the baptismal one that Pauli received when Mach became his godfather.[686] Pauli sees him shaking Jung's hand amiably in agreement. Jung's definition of physics as 'the science of physically labelled ideas' was entirely consistent with the thinking of Mach. Mach would also have been delighted that Jung had banished metaphysical judgements 'to the shadowy realm of primitive animism', as he evidently used to put it. Pauli continues to draw parallels between the viewpoints of Mach and Jung:

> What is interesting in connection with your letter is Mach's attempt to fall back on psychic facts and circumstances (sensory data, ideas) within the realm of physics as well and especially to eliminate as far as possible the concept of 'matter.' He regarded this 'auxiliary concept' as grossly overrated by philosophers and physicists and viewed it as a source of 'pseudo problems.' His definition of physics basically coincided with the one proposed by you, and he never failed to stress that physics, physiology, and psychology were 'only different in the lines of investigation they took, not in the actual object,' the object in all cases being the constant psychic 'elements' (he exaggerated their simplicity somewhat, for in reality they are always very complex).[687]

The essential difference between Jung and Mach is their view of the 'psychic elements' which form the basis of all sciences. To Mach, these consist of simple perceptions, whereas Jung saw them as the result of a complicated interplay between an internal and an external objective world. Pauli is surprised at Jung's criticism of what came to be called 'positivism', as Jung's own viewpoint shows so many fundamental points of agreement with it. In both cases, an elimination of certain thought processes – the avoidance of concepts that are not directly ascertainable – is involved. Here we may remind ourselves that

[685] Pauli to Jung, 31 Mar. 1953 [60P], *PJL*.
[686] This baptismal goblet is today kept in 'La Salle Pauli' at CERN.
[687] Pauli to Jung, 31 Mar. 1953 [60P], *PJL*,104.

Pauli himself adopted this viewpoint in the 1920s and that it is from his own experience that he goes on to say:

> But then one soon sees that one does not understand anything – neither the fact that one has to assign a psyche to others (only one's own being ascertainable) nor the fact that different people speak of the same (physical) object (the 'windowless monads' in Leibniz). Thus, in order to meet the requirements of both instinct and reason, one has to introduce some structural elements of cosmic order, which 'in themselves are not ascertainable.' It seems to me that with you this role is mainly taken over by the archetypes.[688]

The dream of constructing a science from purely ascertainable facts can never be realized. One must always introduce 'non-ascertainable' or theoretical and structural elements in order to obtain a worldview that is at all comprehensible. On the other hand, Pauli agrees with Jung that metaphysical statements should be avoided as far as possible and only be permitted when they fulfil a pragmatic function, for example if they can clarify the *possibility of ascertainment*. In science, the pragmatic *usefulness* of a statement fulfils this function. The question which justifies the introduction of non-ascertainable statements is: Does this help to bring order to the facts? In mathematics the formal logical statement of consistency makes such a structural element. In psychology the concepts of *the unconscious* and the *archetypes* fulfil this function and in atomic physics one speaks of 'the totality of the characteristics of an atomic system', which are not all ascertainable at the same time.

Yet Pauli now asks himself whether the concept 'psyche' can be used about something that goes beyond the purely ascertainable. He questions whether the epithet 'psychic' really can be applied to the concepts of the unconscious and the archetypes. It cannot be right to call the archetypes, which are by definition not in themselves directly ascertainable, 'psychic'. A clear distinction must be made between the experience of the individual – which is undoubtedly of a psychic nature – and the general concepts which one uses to explain this experience. The concepts themselves must not have special labels, they must be *neutral*. Pauli had already discussed this subject with Markus Fierz as early as 1948, when he maintained that the ordering and regulating principles must be placed beyond the difference between psyche and matter.[689] Therefore Pauli did not think that Plato's $\tau\rho\iota\tau o\nu\ \epsilon\iota\delta o\zeta$ should be equated with 'psyche'. He referred to Jung's own words in the article *Der Geist der Psychologie* [The Spirit of Psychology] – that the archetypes can no longer

[688] Pauli to Jung, 31 Mar. 1953 [60P], *PJL*, 104. Translation altered by the author.
[689] Pauli to Fierz, 7 Jan. 1948 [929], *PLC III*, 496.

definitely be described as psychic.[690] Jung's concept of the psyche was according to Pauli at great risk of becoming 'overloaded', i. e. of expanding beyond its proper limits and consequently turning into a tautological or redundant concept. Jung comes close to repeating the mistake of Platonic idealism which isolates the psyche from the material and natural processes.[691]

Jung declares that he wishes to use Plato's concept metaphorically to describe the intermediary function of the psyche; the psyche is the medium where ideas of physical and spiritual origin take place.[692] Matter and spirit are postulated concepts, not ascertainable in themselves, which act as explanatory working hypotheses. The same applies to the psyche and its working concepts 'the unconscious' and 'the archetypes'. Jung had written in his 1946 essay that the concept of the unconscious must remain provisional until it is possible to substantiate it.[693]

Jung becomes visibly irritated at Pauli's designation of him as a positivist.[694] But Pauli was not alone in calling him this. Josef Goldbrunner claims the same:

> 'What God is in Himself' is a question beyond the scope of psychology. This implies a positivistic, agnostic renunciation of all metaphysics. It is possible that metaphysical objects have their share of existence, but 'we shall never be able to prove whether in the final analysis they are absolute truths or not.' In saying this Jung clearly stands – as he himself admits – 'on the extreme left wing in the Parliament of the Protestant spirit'. One might therefore think of Jung as a positivist since in his view only the natural sciences lead to positive knowledge. But it must be added at once that he has penetrated and extended brutal positivism and fought for the 'reality of the psyche'. He has acquired a new province for empirical knowledge.[695]

It was the refusal to become involved with the question of 'God himself' that brought upon Jung the charge of 'positivism' and, more particularly, of 'psychologism', from the theologians and other believers. Psychologists and others, on the other hand, called him 'obscure' and 'mystical' because he tried to describe and understand the, in many ways, tricky conceptual world of the heretics, mystics and alchemists. Jung explains his position like this:

> The epithet 'psychologism' applies only to a fool who thinks he has his soul in his pocket. There are certainly more than enough such fools, for although we know how to talk big about the 'soul', the depreciation of everything psychic is

[690] Jung, 'On the Nature of the Psyche', *C.W.*8, §420, 439.
[691] Pauli, 'Ideas of the Unconscious', *WPP*, 154.
[692] Jung to Pauli, 4 May 1953 [61J], *PJL*.
[693] Jung, 'On the Nature of the Psyche', *C.W.*8, §370.
[694] Pauli to Jung, 31 Mar. 1953 [60P]; Jung to Pauli, 4 May 1953 [61J], *PJL*.
[695] Josef Goldbrunner, *Individuation: a Study of the Depth Psychology of Carl Gustav Jung* (London, 1955), 161–162.

> a typically Western prejudice. If I make use of the concept 'autonomous psychic complex', my reader immediately comes up with the ready-made prejudice that it is 'nothing but a psychic complex'. How can we be so sure that the soul is 'nothing but'? It is as if we did not know, or else continually forgot, that everything of which we are conscious is an image, and that image *is* psyche. The same people who think that God is depreciated if he is understood as something moved in the psyche, as well as the moving force of the psyche – i. e. as an autonomous complex – can be so plagued by uncontrollable affects and neurotic states that their wills and their whole philosophy of life fail them miserably. Is that a proof of the impotence of the psyche? Should Meister Eckhart be accused of 'psychologism' when he says, 'God must be born in the soul again and again'?[696]

Jung wanted to 'peel the shell off' the metaphysical concepts and representations and penetrate to their psychological core, to their operational centre. This 'something' is always emotionally charged and can seldom be described in rational terms. Man has given certain specific, strong experiences the designation 'divine'. What characterizes the concept of God is that it expresses the *highest psychic value*. In the terms of analytical psychology the experience of God coincides with a conceptual complex that concentrates within itself the highest amount of psychic energy.[697] It is not God himself but the 'divine experience' as a psychic phenomenon that displays similarities with the phenomenology of a 'autonomous complex', i. e. an independence and sovereignty that are expressed in its power to elude our will, to invade our consciousness and to affect our moods and actions.[698]

Jung felt that it was wrong to charge him with 'psychologism' or 'positivism'. He had often spoken very negatively of positivism, which he identified with nineteenth-century materialist empiricism, a kind of naive realism that expresses the opinion that the things and events of the world are independent of man and his epistemological apparatus. What particularly disturbed Jung about this theory was that it did not take into account man as an observer, and so ignored the subjective factor.[699] It was thus largely against older, ontological positivism that Jung was raging, whereas Pauli compared Jung's viewpoint to the new epistemological positivism – particularly represented by Mach.[700] Jung identified positivism with an 'unbalanced belief in scientific truth'. To him this was identical with the naive perception that scientific hypotheses constitute eternal and lasting verities.

[696] Jung, 'Commentary on ›The Secret of the Golden Flower‹', *C.W.*13, §75.
[697] Jung, 'Psychological Types', *C.W.*6, §67.
[698] Idem, 'The Relations Between the Ego and the Unconscious', *C.W.*7, §400; idem, 'Answer to Job', *C.W.*11, §749, note 2.
[699] Idem, 'Psychological Types', *C.W.*6, §621.
[700] Pauli on other occasions states that he can't make sense of the term neopositivism. See page 86.

Moreover he associated positivism – correctly – with a ban on speculation on what lies beyond the empirically verifiable. This was a long way from his own position.[701]

To Jung the concept of God represents a psychic fact. In just the same way the concepts of 'matter' and 'energy' represent psychic facts for the simple reason that the human psyche experiences, measures and observes these categories. This assertion does not mean that one has said anything about what 'God' or 'matter' are in themselves, nor, on the other hand, that one denies that what causes these experiences exists. Nor is it meaningless to speak about God or to speculate on the innermost nature of matter, on the contrary, this is a precondition of future knowledge. Man will always speculate on the non-ascertainable and extract from it that which is ascertainable.[702] He could even imagine that man – at moments of great inspiration – might sometimes have the capacity to go beyond his epistemological boundaries and gain insight into the transcendental order of reality. To Jung as a psychologist, however, it was the ideas themselves, their dynamics and effects, that constituted his empirical material – not speculation on their place of origin or actual existence. He wanted his viewpoint to be seen as an epistemological and scientific demarcation of his sphere of activity, not as a prohibition of speculation on the 'non-ascertainable'.

Jung could not come to terms with Pauli's criticism that he had expanded the concept of 'psyche' beyond its permitted boundaries. As long as the archetypes are expressed in conceptions and actions it is correct to call them 'psychic'. But if one speculates on their ultimate, non-visual nature it is naturally no longer permitted to call them psychic. Jung therefore introduced the speculative concept *psychoid*, which means that something comes to us in a psychic form, but is not necessarily of a psychic or intra-mental nature. The introduction of this concept may be seen as a concession to Pauli, because it represents an attempt to approach a *neutral* language – it incorporates the existence of a non-psychic reality. Jung now says that an object can only be called psychic if it is *only* ascertainable as a *concept* (*Vorstellung*). One must naturally distinguish between a 'pure' psychic phenomenon – such as an illusion – and a phenomenon which has its basis in an extra-psychic existence of its own. Although the psyche is our only instrument of cognition and therefore indispensable to every statement, the objects of our experience and knowledge are only to a very small extent psychic. What is inescapable is that all objects of experience are presented through the psyche and that in

[701] 'Jung and Religious Belief' (1958), *C.W.*18, §1591.
[702] Jung to Pauli, 4 May 1953 [61J], *PJL*.

this process they cannot bring their own substance into the psyche with them but are 'psychified'. When the objects become experiences or knowledge they lose their substantive existence. However it must never be forgotten that the objects of our experience are outside our psyche and represent *existences*. Jung agreed with Pauli that the archetypes must be counted among these transcendental autonomous existences about whose innermost nature we know nothing. Were they only psychic, they would be human inventions, not autonomous forces. Pauli seems largely to have been satisfied with the reply he received from Jung.[703] To von Franz he writes:

> … his last letter contains for example quite excellent elaborations on the unity of the individual as a microcosm which has to be related to the unity of the description of nature. I can confirm this in detail and even verify it.[704]

Despite this elucidation, the same criticism comes from Pauli again in 1954–55. Pauli had for some time prepared an essay to mark the occasion of Jung's eightieth birthday.[705] In this anniversary contribution Pauli, true to form, criticizes aspects of Jung's terminology. This shows that Pauli watched Jung's pronouncements like a hawk – particularly those that concerned unclear distinctions between psyche and the non-psychic. Here Pauli repeats his criticism of Jung's way of using the term 'psyche', i. e. the logical inconsistency in the way Jung defines the psyche as both a 'conscious-unconscious whole' as well as something 'immediately given'. Only the facts of consciousness can be 'immediately given' and a 'conscious-unconscious whole' must be something that reaches beyond the psyche into the unknown and should therefore be designated as 'neutral'.[706]

Now the question concerned Jung's way of using the term 'psychic statement'. According to Jung all human statements, regardless of content, are 'psychic statements' and may be used as a basis for studying the psyche. Pauli observed that such a concept has to be regarded as logically *pleonastic*, like the expression 'white roan'.[707] Jung clarified what he meant in a letter to Pauli, in which he said that he only wishes to use the term 'psychic statement' if the statement has its origin in the objective psyche, in other words in the spontaneous products of the unconscious, such as dreams, mythology, delusions

[703] Pauli to Jung, 27 May 1953 [62P], *PJL*.

[704] Pauli to von Franz, 15 May 1953 [1572], *PLC IV/2*.

[705] Wolfgang Pauli, 'Naturwissenschaftliche und erkenntnistheoretische Aspekte der Ideen vom Unbewussten', *Dialectica* 8, No.4 (15 December 1954), 283–303. Cf 'Ideas of the Unconscious' *WPP*.

[706] This issue is raised in a number of letters; see Pauli to Meier, 6 February 1954 [1713], *PLC IV/2*; Pauli to Kröner, 16 January 1955 [1979], Pauli to Bohr, 15 February 1955 [2015]; Pauli to Jaffé, 20 October 1955 [2166], Pauli to von Franz, 27 October 1955 [2173], *PLC IV/3*.

[707] 'Ideas of the Unconscious', *WPP*, 154, footnote 9.

and so on. Psychic statements are therefore statements in which consciousness has played a subordinate role. Statements which derive from rational reasoning or represent results of a conscious processing cannot be called 'psychic statements'.[708] Pauli felt satisfied with this contextual limitation.

In his later years Jung increasingly stressed that psychic reality does not represent the whole of reality, but it is the part of reality that we can grasp and present. Our picture of reality is incomplete, but it is the only picture of reality we have. Nevertheless there is much to indicate that there are potential realities beyond our representations, not least because our view of the world seems to have the capacity for infinite expansion and change. Science is after all full of evidence that our representations adequately correspond with 'the thing in itself'. But we must never forget that our assumption of this metapsychic existence remains hypothetical. It is always via the representations that we approach reality. In this sense we are locked in the psyche, despite the fact that we can expand our prison to global proportions. This idea is in many respects reminiscent of Leibniz' windowless monads, with the difference that Jung believed that the psyche has windows 'through which we will be able to perceive ever more scenes true to reality'. The psychic aspect of reality remained the most important to Jung.

[708] Jung to Pauli, 10 Oct. 1955 [67J], *PJL*, 132.

Symmetries

Pauli had criticized Jung for extending the concept of psyche beyond its permitted boundaries. By doing so, Jung risked falling into the old trap of idealism and creating a one-sided 'psychistic' worldview which takes no account of material reality. This would nullify what Pauli originally found revolutionary and forward-looking in Jung's psychology: a model where the opposing pairs are treated in a symmetrical manner and a design for a psychophysically unified view of the universe. Pauli's criticism forced Jung to try to bring a little order to his terminology. But if Pauli compelled Jung to express himself with more clarity, Jung continually pushed Pauli to expand his worldview. This was also the case in their discussion concerning the 'spirit' in relation to 'psyche' and 'matter'. In his letter to Pauli on 4 May 1953 Jung emphasized that the simple dualism between body and psyche of more recent intellectual history had led to the spirit's losing its position as a quality of its own. The spirit had been identified with the human intellect, robbed of its autonomy and subjected to arbitrary human will. We therefore find it hard to see the spirit as something separate from the psyche, whereas we have no problem at all in ascribing an independent existence to matter. Jung here referred to his own need to think symmetrically; the opposites must be granted the same right to existence:

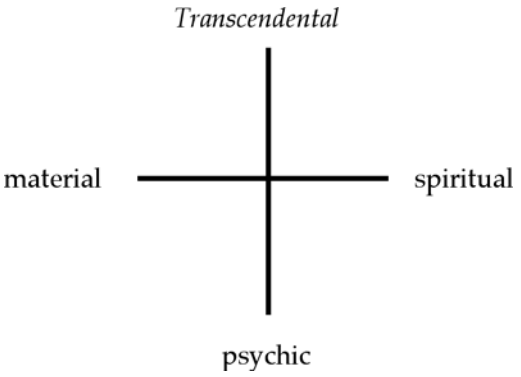
> I do not know whether my inclination to symmetrical points of view is pure prejudice, but it seems to me essential to think in a complementary way: to matter belongs nonmatter, to above below, to continuity discontinuity, and so on. The one is a condition of the other..[709]

The picture that Jung wanted to propose was therefore like this. It is not the physical and the psychic that represent opposites, but the material and the spiritual plus the psychic and the transcendental (see figure on next page).

What is fundamental and verifiable in reality is of psychic nature. Psychic reality is made up of phenomena that are perceived as having different origins, either material or spiritual. The opposite of the verifiable psychic experiences on an epistemological level is the transcendental, which so to speak summarizes the innermost nature of the other categories, about which

[709] Jung to Pauli, 4 May 1953 [61J], *PJL*.

Jung's view of reality[710]



we can know nothing. The psychic, intra-mental reality is in opposition to the innermost nature of transcendental, non-visual reality. Transcendental reality is the whole and the one, it is the so-called unified reality: *Unus mundus*.

> Insofar as the spiritual exists, the psyche has a part in it. This participation is ascertainable in that there are conceptions which are labeled partly of spiritual, partly of material origin. But how this participation is constituted in reality cannot be ascertained because matter, psyche, and spirit are in themselves of an unknown nature and thus are metaphysical or postulated. Thus I fully agree when you say 'that psyche and matter are governed by common, neutral etc. ordering principles'. (I would simply add 'spirit' as well.).[711]

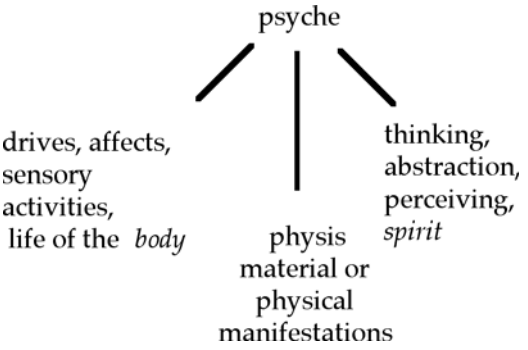
The neutral ordering factors that Pauli seeks must be located on this transcendental level and their effects traced in the other three regions. Matter, psyche and spirit all represent transcendental non-provable categories that seem to be regulated by common, *neutral* (i. e. neither spiritual nor material) ordering principles. In this scheme we thus obtain the classical division of 3+1, where the fourth also represents the unity of them all.

To Pauli it was obvious that one had to distinguish between 'intellect' and 'spirit', but he could not understand how one could distinguish between 'psyche' and 'spirit'.[712] Jung attempts to clarify how he sees the relationship between psyche and spirit in subsequent letters to Pauli. Psyche, as we have seen, is to Jung the overall concept that designates the substance of the phenomena of inner life. Spirit on the other hand forms a special category of these inner phenomena, whose existence cannot be derived from the body or from the external material world. Here belong, for example, the spontaneous

[710] Ibid.
[711] Ibid. Translation altered by the author.
[712] Pauli to Jung, 27 May 1953 [62P], ibid.

pictorial processes which may form the basis of abstract ideas, but also the deliberately produced abstractions that find expression in man's codified systems of thought. Jung used another mental picture to illustrate this:

The relationship between psyche, body, matter and spirit



In this case Jung visualized the psyche as a counterpart of matter, since the psyche, just like matter, forms a *matrix* which produces phenomena. As matrix or original substance both psyche and matter are unknown as far as their innermost nature is concerned and therefore practically indistinguishable. Only at second hand do they appear as two aspects of our reality. Spirit and body, on the other hand, have always been opposed categories of experience.

In Jung's model the psyche is equated with the position of the soul in the Neoplatonist and hermetic tradition. *Anima* is understood in this tradition as *ligamentum corporis et spiritus* – ligament of the body and spirit, in other words a factor which unites corporeal and spiritual. We do not know what psyche and matter are in themselves, but we can study the phenomena of the psyche by observing both its physiological and its spiritual (ideological) components. Likewise we can study the phenomena of matter with its different, mutually exclusive features, such as wave and particle. Matter borders on and goes over into the biological processes and at the same time it displays strongly 'spiritual' features in its mathematical structure. Jung states therefore that there must be at least *two ways* to the secrets of existence: by studying the material processes and by studying the psychic processes. Whether the process of matter is reflected in the psyche or the process of the psyche is reflected in matter would appear to be impossible to decide. The interesting question therefore becomes where these two fields of study meet. Jung thought that they meet in the mystery of the natural numbers.[713]

[713] Jung to Pauli, 24 Oct. 1953 [64J], ibid.

Pauli felt very satisfied with this statement:

> In doing so, I should like to stress my basic agreement with your demand for a middle or superior position for the psyche in relation to body and spirit and also with your adopting of two roads to the secret of Being. I have indeed seen the same relational problem between the different aspects of the Self on the one hand and the different aspects of the anima on the other, both in my personal problems and in the problem of physics in relation to other sciences and to life as a whole.[714]

Pauli speculated on whether one may see the psyche as a mountain with variations in illumination: if the spiritual perception is illuminated, the physiological will be in shadow, if the physiological is illuminated, the spiritual will be in the shade. But it is the same mountain![715] We see here how Pauli finally seemed to have accepted the idea of the psyche as a mediating factor – a conception which he initially saw as a psychologistic or 'unsymmetrical' one – when Jung was able to present a 'symmetrical' picture of the relationship between psyche, matter, body and spirit.

The search for a symmetrical position in relation to the conscious and unconscious was a central theme for Pauli during the years 1948–1956. For him it involved the most important and philosophically decisive question both in modern physics and in Jung's psychological ideas. It concerns the view of the relationship between cause and effect, between possibility and realization, static and dynamic, part and whole. The question may be phrased in many ways, but Pauli linked it to the central question in quantum physics: What role does the actual moment of observation play in our knowledge of reality? Can any distinction be made between 'reality as it actually is' and 'reality observed'? Must all reality always be seen as an interaction between observation and object? Is reality actually created at the moment we make an observation or is it waiting to be discovered by us? Do we lay our mental screen over reality or is it reality that forces itself on us and compels us to insight (projection or introjection)? These are the great and eternal philosophical questions that arise again in the discussion between Pauli and Jung.

[714] Pauli to Jung, 23 Dec. 1953 [66P], ibid. Translation altered by the author.
[715] Pauli to von Franz, 12 Nov. 1953[1672], *PLC IV/2*.

Consciousness as a Release

'There is nothing optical in my thinking. When I imagine something I see nothing before my eyes therefore I prefer not to rest my eyes on representations of any kind, whether they are aesthetic or not.' So says Kurt Guggenheim's character Paul Mende.[716] Paul Mende is a portrait based on Pauli. In the story Paul Mende has refused to allow Jolande (Franca) to hang pictures on the wall, neither Flammarion's star watcher, nor Picasso's *Guernica* nor a van Gogh will do. He prefers to stare at the spotted white surface of the wall.

It was Pauli's interest and focus on the relationship between subject and object that also forced Jung to clarify his own position on this question. Although the unconscious is regarded as a *psychic* factor by Jung, he does not count it as a *subjective* factor. The unconscious, in particular the *collective* unconscious, is a separate autonomous 'objective' reality in relation to consciousness. The image from which Jung originally sets out is that of consciousness being 'struck' by the unconscious, as if it 'wanted' something from us. This pressure from the unconscious finds expression in the religious beliefs of human kind. Most religions and mythologies depict the intra-psychic drama which all humans go through: the drama of developing from an unconscious being into a conscious one. Jung wishes to see the whole of Western religious history in this light. The progress from heathendom to Christianity is the story of the growth of human consciousness and its increasing domination of the unconscious – for better or worse. In symbolic terms Jung expressed this process with the words 'God wants to be born in man's consciousness and needs man in order to become conscious'.[717]

According to Jung, the unconscious state corresponds to man's original experience of wholeness. An example of this is the postulated heavenly state which the infant experiences as long as it is identical with its surroundings. This original state of wholeness, before consciousness has begun to manifest its distinguishing properties, is identified with the experience of being at one with God. Jung assumes that man's conception of God reflects the relationship but also the conflict between conscious and unconscious. In the same way Judaeo-Christian mythology deals in symbolic form with the idea that God is

[716] Kurt Guggenheim, *Gerufen und nicht gerufen* (Zürich, 1973), 182.
[717] See for instance Jung to Walter Robert Corti, 30 Apr. 1929, *C.G.Jung Letters*, vol. 1, 65.

trying to become conscious of himself via man. The theme is the mystery of human consciousness, its derivation and purpose. Jung sees consciousness as a recent product which arises from the primeval sea of the unconscious. The paradox lies in the observation that on the one hand the unconscious brings forth consciousness, yet seems also to be so conservative and 'inert' that every expansion of consciousness demands a terrific exertion. At the same time consciousness seems to be of a very delicate make-up which is constantly threatened with disintegration by being 'swallowed up' by the unconscious, as happens, for example, in psychoses.

There seems therefore to be both a consciousness-creating and a consciousness-destroying force in the psyche, which seem to function like biological processes, building up increasingly complex and vital structures and organisms, while at the same time causing destructive disorders. Jung sees the closest parallel with the biological and organic processes in the self-regulating system of the psyche, which chiefly manifest themselves in the mechanism of compensation, of which the production of mandala structures mentioned earlier is one example. At the same time as compensation proceeds almost mechanically on an unconscious level, we have in this mechanism, if we learn to consider the products of compensation such as dreams, an outstanding opportunity of expanding our consciousness. In cases of extreme imbalance it even seems as if the unconscious itself 'wants' to force us to consciousness – it becomes impossible for us to carry on living in the one-sided state because the psychic system suffers a neurosis. To Jung it was self-evident that the neurosis had not only a cause but also a purpose. Just as a physical illness makes us aware that something is wrong, this is the psyche's attempt at self-help. Like the dream, it is an effort to restore the psychic balance, but in a more drastic manner.[718] The purpose of the neurosis is to increase consciousness or to contribute to insight and self-realization. The neurosis shakes the laziest and most recalcitrant individual out of his apathetic unconsciousness.[719]

In that sense Jung believes that a spontaneous process of maturing is taking place in the unconscious which is quite independent of whether consciousness is interacting with the unconscious or not. The unconscious shows a kind of direction, intention or will and acts as a driving force behind the development of consciousness. This direction is assumed to come from the *Self*, the self-regulating and self-organizing centre and circumference of the psyche. The Self has a function in the psychic sphere similar to that of the endocrinological system in the physiological: to maintain a balance that per-

[718] C.G.Jung, 'The Tavistock Lectures' (1935), *C.W.*18, §389.
[719] Idem, 'The Relations Between the Ego and the Unconscious', *C.W.*7, §290.

mits the survival and maturity of the organism. This psychic self-regulation strives towards wholeness and balance in each individual and its tool appears to be expanded consciousness.[720]

Most cultures describe the birth of consciousness in mythological form and associate it with some form of violation or violent act. This initial mutilation of the original totality is for man the beginning of a long journey through alienation and darkness, whose aim is to reconnect him with the totality. This process is described in most religions.[721] So also in Christianity. Jung saw the dialogue between God and man as a symbolic expression of the perpetual interaction of conscious and unconscious. He could therefore never accept an absolute concept of God. To say that God is absolute places him beyond any contact with man. Such a God cannot influence man and man in turn cannot have any effect on such a God. An absolute God is detached and separated from man. Only a *psychological* God, in other words a God who is relative to man and who interacts with man, is real.[722] What is important to Jung is how man *perceives* God, not what God *is* in a metaphysical sense. As man's image of God reflects man's relationship with a greater whole, it also represents a symbolic expression of the relationship between conscious and unconscious.

Here one must recall Jung's specific view of the unconscious. It is not a receptacle for suppressed material but our living and creative psychophysical source. To Jung the unconscious is synonymous with a 'non-visual reality' which is always *acting* on us. Jung felt that he had shown in his association experiments – satisfying every scientific requirement – that this 'non-visual reality' is not simply a religious or philosophical concept. The unconscious is something which acts on man so palpably that it has an effect on psychophysical measurements. The conception of God constitutes, according to Jung, a symbolic expression of man's mental totality, in other words the very relationship between conscious and unconscious. From this point of view 'God's wish to be become conscious' means the same as the 'will' of the unconscious to become conscious.

That the unconscious should contain intentions, 'will' or semi-conscious contents was a notion that Pauli could not accept. In 1950 Pauli starts a lively debate on the matter set off by a passage in Aniela Jaffé's book on the symbols in one of E.T.H. Hoffmann's works.[723]

[720] Jung, 'Psychology and Religion', *C.W.*11, §232.

[721] See, for example, Erich Neumann, *The Origins and History of Consciousness* (1949), (New York, 1954); Edward F. Edinger, *Ego and Archetype* (Baltimore, 1973).

[722] Jung, 'The Relations Between the Ego and the Unconscious', *C.W.*7, §394, footnote 6.

[723] '. . . not only do the unconscious contents (left) force their way into the consciousness of man, but God (right) seeks the man, to become conscious himself'. Aniela Jaffé, *Bilder und Symbole aus E.T.H.*

> 'God seeks man in order to become conscious himself', is not something I can go along with. I am convinced that beyond human consciousness there is unfortunately Nothing that 'becomes conscious of itself'. In this I find myself in agreement with Yoga teaching and with the Taoteking. The assumption of an extra-human (divine) consciousness leads to the most absurd illusory problems of good and evil (in this I am a true disciple of Schopenhauer). But these problems only exist in the heads of people confused by monotheism and not in nature and in the cosmos. In Chapter 5 of the Taoteking ('Heaven and earth are ruthless, and treat the myriad creatures as straw dogs…') everything necessary on this subject seems (in a few lines) to be said.[724]

Pauli regarded the relationship between conscious and unconscious similarly to the relationship between measuring instrument and object in quantum physics. He therefore made the influence of *consciousness* the key point in his consideration of the matter, but also asserted that every expansion of consciousness results in an irreversible transformation of the psychic system as a whole. To Pauli it was essential to underline that mental content can only be changed if it is observed – or, expressed differently: the archetypal patterns can only undergo change by means of an intervention from consciousness. The unconscious material certainly carries the potential for future development, but it must be 'released' by consciousness, which is itself expanded in the process.[725] Pauli sees consciousness as the active part in the drama (more so than Jung), while the unconscious is more passive and helpless. It can create a disturbance to be sure, but it cannot have any kind of consciousness or 'intention'. Pauli may to some extent have changed his mind concerning this question later in life, as he seems to have wanted to make room for the experience that there is something in the unconscious, or alternatively from a 'higher' plane, that *demands* widening of consciousness.[726]

On one occasion Pauli summarizes his attitude with the aid of an extended poetic metaphor. He is very careful to underline the unscientific nature of this way of expressing himself. 'The stranger' is a figure who appears in Pauli's dreams, and he embodies the antithetical position of the unconscious to the conscious attitude. Pauli says that the stranger longs for a release, a release that only the ego can give him.

> *Ego-consciousness is a invasion of the world of the stranger*, just as the stranger is a invasion of the world of the 'Ego'. The stranger does *not* know in advance

Hoffmanns Märchen 'Der Goldene Topf' (1950), 3rd ed. (Einsiedeln, 1986), 354. See also Pauli to Pais, 17 Aug. 1950 [1147], *PLC IV/1*: 'A different idea, which does not mean a thing to me, is the theology of a God, who himself wants to become conscious'.

[724] Pauli to Jaffé, 28 Nov. 1950 [1172], ibid.

[725] Pauli to Jung, 27 Feb. 1952 [55P], *PJL*.

[726] Conversation between Wolfgang Pauli and Hans Bender on April 30, 1957. See Appendix to letter [2586], *PLC IV/4i*.

what the 'ego' will do. The only thing that the 'ego' knows *for certain* about the stranger is that he will definitely make himself noticed in an 'ordering' (possibly disturbing) manner, if he feels *neglected*. For he wants something from the 'ego' – he does *not* want a 'holiday from the ego' – he wishes the ego to 'strike' him, for that and only that means (at least temporarily and partially) *release* to him. He is thus, to put it briefly, *in need of release*, and this character is missing from Schopenhauer's 'will'. I do not know how the 'stranger' relates to animals and plants; but since man is there, he is aiming chiefly for *him*. As far as 'knowing', as 'unconscious conception or picture', exists in the stranger, it seems rather to me that the human ego consciousness can *break* through it and indeed that this is just what the stranger '*wants*'. From man's point of view the 'stranger' has both 'good' and 'bad' characteristics, he carries on a continuous, never-ending *experimentation* with man (or people) and he loves keeping him in *tension* and *conflict*. Only *then* does the ego seem able to 'strike' him. To achieve this, he must occasionally take the trouble to bring his expressive capacity in words and images close enough to the world of the 'ego' for the latter to be able at least roughly to understand, to 'comprehend' him. That must be very difficult for him, because his world is totally different from that of the ego. Even if his 'knowledge' is diffuse [broad] as that of the migrating bird, his freedom of action seems to me restricted by the rules of the humanly ascertainable (not those of 'causality' in the narrower sense though). He is already *unfree*, by his fateful deliverance-seeking commitment to human self-awareness. *'Freedom of will'* (which includes moral responsibility) *is something man has*, but the 'stranger' has *not*.

[–––]

All this now resembles a myth, which always fascinated me, as if it were also my own, personal myth: it is the old story of Merlin, which I – now 'fantastically' expressed – want personally to pass on (not necessarily remaining related to the idea of the Grail). In the old story he arose from the union of the *devil* and a good and pious woman. He himself is then both good and bad. In modern terms: from the union of the negative 'shadow' and a positive 'mother anima' arises a 'light-dark', 'good bad' son: the 'stranger'. Like Merlin, he *knows* the future, but cannot change it, nor the place in which he is 'shut away' (see the Merlin story). In my opinion, however, *man can alter* this 'future'.

The old history of Merlin has of course no ending. He does *not* die, carries on living in a castle in the air or an 'ivory tower', seen by no man, watched over by a 'pagan anima', Diana or Vivien, who wants to have him for herself.

I do not want Vivien but I do want to take Merlin, whom she keeps prisoner, back from her. I want to recognize him, talk to him again, bring his redemption a little nearer. That, I believe, is the myth of my life.[727]

In the same way as Jung, Pauli links the concept of the unconscious to the God-image of a culture. Just as it is wrong to attribute intentions or wisdom to the unconscious, likewise one must not credit God with any positive attributes such as omnipotence or goodness. To Pauli there is only one solution to the age-old ethical and theological problem of the divine attributes; one must assume a *negative* theology. Such an 'unknown' God coincides more closely

[727] Pauli to Jaffé, 23 Jan. 1952 [1350], *PLC IV/1*.

with the Taoist stance and with the inconceivable God of the Gnostics, who is beyond all attributes.[728] Here Pauli feels that he differs from Jung when it comes to the interpretation of the book of Job. While Jung has a tendency to be upset by God's and Satan's *sadistic* play with Job, Pauli sees them as forces of nature, without ethical responsibilities. He wonders if this could represent a more Jewish way of seeing things, a greater acceptance of the relativity of the ethical concepts, while Christians crave a clear-cut picture of sin and righteousness. Characteristically he sees the story of Job as a parable of how Job needed to get rid of his innocent and naive view of God (through confrontation with his unconscious), and the morale is that Job had to broaden his consciousness. Jung on the other hand sees it as a story of God's need to become conscious of himself.[729]

The view of God as an unfathomable force acting in life and in the cosmos places God in the centre of existence and avoids the mistake of making a sharp distinction between the spiritual and the material. Such a view is also close to the idea of a kind of impersonal life force, an instinct or 'will' in Schopenhauer's sense. But, wonders Pauli, can this 'unconscious' God, who cannot be held responsible for the state of the world, can this 'unknowing' and 'innocent' God help modern man? In modern man it is the relationship between God and man that is lacking, a void which longs to be filled. Schopenhauer's solution lay in his negative attitude to 'the will'; it was something from which one had to try to free oneself by aesthetic contemplation. On this point Pauli was *not* in agreement with Schopenhauer. We must not turn away from 'the will' – that would be a flight from reality. Instead we must turn towards it, our great task is to release it.[730]

This attitude leads Pauli to turn away from most religions and philosophies – Christianity, Platonism, the yoga of the East all strive to get away from the conflicts of this world. Their routes to salvation are through an ecstatic state which frees man from the material object and they regard the achieving of an objectless 'pure' consciousness as a desirable goal. To modern man (i. e. Pauli himself), such a goal is one-sided and unsatisfactory. We must

[728] Jung meant that the God of the gnostics was not merely inconceivable and beyond all attributes, but also unconscious, in a state of agnosia (non-knowing). He identified this unconscious, inconceivable God with the experience of the numinosity of the unconscious. Even if most gnostic writings describe the origin of all (the self-generating original principle, Autopator) as the light, the truth, the idea and cognizance or knowledge (acquaintance/knowledge/ennoia/gnosis), this does not mean, according to Jung, that the original principle or the highest God is conscious. It contains consciousness, but it is not conscious. One ought rather to see it as the original principle potentially containing everything, even the possibility of consciousness. Jung, 'Aion', *C.W.9 II*, §298. Compare also 'The Secret Book According to John', *The Gnostic Scriptures*, ed. Bentley Layton (New York, 1987), 29–30.

[729] Pauli to Jaffé, 8 November 1951 [1303], 11 November 1951 [1304], *PLC IV/1*.

[730] Pauli to Jung, 27 Feb. 1952 [55P], *PJL*.

not try to flee from the opposing poles of life. Modern man should instead try to create an equilibrium between the opposite pairs: spiritual/material, psychic/physical, good/evil, light/dark and so on. This striving for an equal attitude to opposing pairs is something that modern man shares with the alchemists' route to salvation. It is through work (*opus*) with real substances that something of value is created, through the encounter (*coniunctio*) between the spiritual and the material. But modern man naturally sees the way to a reconciliation between the opposing pairs in a different manner from that of the alchemists. Modern Western man cannot be content with 'perceiving' nature but is driven by the *will to understand*. In order to reach a unified and reconciling worldview based on *knowledge* both psychology and physics are still a long way off.

> If the aim for us is the same as for alchemy, the route to it must nevertheless mutatis mutandis be different.
>
> To get so far in our understanding (as opposed to our direct *experience*) of nature, *both* physics *and* psychology have still, it appears to me, a long way to go. These 'drawers' are still separate, and only in our dreams is anything like an aurora consurgens of a future unity to be seen. To my mind, however, such a process cannot be rushed, far less dispensed with.[731]

In this context Pauli took up another of Jung's ideas, namely the idea of a *secular shift in the unconscious worldview*. By this Jung meant the very slow, gradual change in man's worldview.[732] In an essay Jung wrote in 1927 he expounded his view that modern man, in particular, believes he can avoid formulating a conscious *Weltanschauung* by having a 'scientific' attitude. A *Weltanschauung* is a view of the world that marks our approach and attitude to life. This means that it cannot rest only on facts and rationally stated conceptions, but must include the reality of the whole person. Our worldview ought therefore also take the irrational aspects of life into consideration, as for example the influence of unconscious forces on our behaviour.[733] A *Weltanschauung* reflects our view of humanity and our outlook of ourselves and our place in the cosmos. This means that the formulation of a worldview is a demanding task of considerable ethical dimensions. It is naturally much easier to adopt a sceptical or critical attitude to a specific worldview than to formulate an alternative for oneself. An overcritical attitude often hides an inability to adopt a viewpoint of one's own. Pauli had read Jung's essay and highlighted many passages.[734] If there was one thing that had really impressed

[731] Pauli to von Franz, 16 Oct. 1951 [1291], *PLC IV/1*.
[732] Jung, 'Psychology and Alchemy', *C.W.*12, §166.
[733] Idem, 'Analytical Psychology and Weltanschauung', *C.W.*8, §697.
[734] Idem, 'Analytische Psychologie und Weltanschauung', *Seelenprobleme der Gegenwart* (Zürich,

Pauli it was the insight that a sceptical or overcritical attitude often conceals a fear of that which transcends the rationally apprehensible and thus reveals an inability to see reality with all its ambiguities. This had of course been the attitude of Pauli during his Hamburg days (1922–28). '… the naive certainty of my former Hamburg days, with which I could easily declare ›That's all nonsense‹, is something that I have since rather lost'.[735]

A worldview has something to say about man's way of thinking and seeing the world, i. e. about the psyche of man. When the picture changes it is not always easy to decide whether it is the world that has changed or we ourselves, or both. Every new discovery and every new idea may cause the face of the world to assume a new form. A fundamental image to which Jung constantly returns is that of the *compensatory* perspective; there are always at least two viewpoints in the human psyche – the conscious position and the unconscious. The more one-sided the conscious viewpoint, the more extreme will also the unconscious counter-position be.[736] So, for example, rational materialism and mysticism may be seen as two hostile brothers, an opposing pair that always appears together. A person who doggedly propounds a rational materialism is in actual fact nervously protecting himself against the mysticism that he is unconsciously harbouring. By attributing all phenomena to the materially tangible, one more and more imbues 'matter' with mystical qualities. One of the functions of the unconscious is therefore to present us with a kind of inverted mirror image that functions as a counterweight to our conscious worldview.

This also ties in with Jung's view of 'God' as a psychological function. More precisely he links the *idea* of God with the primeval human experience of original wholeness. The idea of 'God' or 'gods' is therefore associated with reflections on our origin and forms the basis of any explicitly formulated creation myth and cosmology. Throughout the ages of human history this explanatory principle has gone through a rationalizing process and the concept of God has gradually given way to universal 'first' principles. Jung calls the archetypal basis and driving force for this explanatory principle the *Self*, the archetype of wholeness and order. It is defined as a superordinate organizing principle encompassing the totality of all psychic phenomena in man and expresses the unity and wholeness of the personality, the unconscious component included. Therefore the Self always encompasses something irrational and inexhaustible and is projected into our wish to continuously explore and

1931), which is in 'La Salle Pauli', CERN, Bellettrarisches No. 95.

[735] Pauli to Hecke, 20 Oct. 1938 [534], *PLC II*, 605.

[736] Jung, 'Psychological Types', *C.W.*6, §694.

understand further aspects of the unknown whole. As the Self represents the psychic totality of the individual, everything that man postulates as a greater unit than himself becomes a symbol of the Self.[737] So even if a small part of the image of God has been transformed into a 'scientific principle', it will shift focus to cover what is still unsolved or what in some way elicits man's awe or, in Jung's terminology, arouses a feeling of *numinosum*.[738]

From a psychological perspective this whole exploration of the unknown, finding first principles, relating to the numinous etc. must also be seen as a development of consciousness. One can therefore, according to Jung, study the development of human consciousness by studying the transformation of the image of God through history. Jung summarized this historical metamorphosis as follows: the most elementary manifestation of the numinous is a general power principle found in most indigenous peoples – carried by objects and animals and gradually assuming increasingly anthropomorphic forms and then in the modern Western world transformed from gods into abstract concepts and principles. These abstract truths are ascribed to our own reason, which in the process is elevated to divine status. With the elevation of reason to the highest authority the divine force has been removed from nature and the cosmos and injected into man, and thereby domesticated as something under man's conscious control. This situation has encountered its greatest challenge with the discovery of the unconscious, which brought man's consciousness and reason back to reasonable proportions. 'The Gods' were thus, as it were, reinstated scientifically by the fact that it could be shown how unconscious complexes display an autonomous existence and thereby influence the life of modern man in a very palpable manner.[739]

Jung was convinced that most modern people who seek the help of a psychologist do so mainly for existential reasons, that is to say that they are in spiritual or religious need. The majority of those who have reached the sec-

[737] The Self may in symbolic form appear as 'the supraordinate personality' in the shape of, for example, a king, hero, prophet or redeemer. As the Self represents the reconciliation of opposites, it may also reveal itself as an opposing pair, for example in the form of a pair of brothers or as hero and anti-hero. The interplay of yang and yin in Taoism, the squared circle, the cross etc. also express this interaction of opposites. The Self is a paradox and cannot therefore really be translated into a visible form. Its symbols often have a very abstract character, as for example in the Pythagorean tetractys or in the expression 'God is a circle whose centre is everywhere and circumference nowhere'. The Self conveys the most intense form of numinosity. Ibid., §791.

[738] Jung borrowed this term from Rudolf Otto, theologian and psychologist of religion, who describes the numinous as 'the ›totally other‹, given in the feeling of a reality inaccessible to our senses and levels of intellect but filled with inexpressible content', but it is also *mysterium tremendum*, 'a terror full of inner dread such as nothing created, not even the most threatening and all-powerful, can instil'. Rudolf Otto, *The idea of the holy: an inquiry into the non-rational factor in the idea of the divige and its relation to the rational* (London, 1923). (Original in german *Das Heilige*, 1917)

[739] Jung, 'On the Nature of the Psyche', *C.W.*8, §359–60.

ond half of life cannot be helped unless they rediscover a religious attitude.[740] By religious attitude Jung meant a relationship to the numinous, i. e. to an intense dynamic power which grips the individual and which compels him to relate to something 'greater' – an experience that forms a part of all religions. Jung seized on the concept of *religio* in its original sense of a *careful and meticulous consideration* or observation of certain dynamic factors which are conceived as 'powers'. Demons, spirits, gods, laws, ideas and ideals are some of the names that man has given these forces.[741]

What Jung is talking about here has little in common with what we normally associate with the word religion, i. e. a specific confession of faith often connected with various dogmas and rituals. In the sense of *careful consideration* of certain dynamic factors Jung also saw psychotherapy or analysis as a religious activity. He noted that patients' problems often have their roots in the 'big' questions like the meaning of life, life after death, and whether there is a God. He observed how religious symbolism appeared spontaneously in patients' dreams, visions and creations. The symbolism may be labelled religious because it shows strong resemblances to the symbolic representations which we find in various religions.

The idea of a *secular shift in the unconscious worldview* is intimately connected with Jung's description of the function of the symbol. Jung sees a living symbol as the best and most adequate expression of something divined but not yet fully known. This 'unknown' cannot be presented in a more apt way than in the form assumed by the symbol. In this way the symbol is a combination of something both known and unknown. The known part of the symbol is represented by its current form, handiness or formulation, whereas the unknown part is based on the impenetrable archetype and the collective unconscious. The state of tension between the known form and the unknown content gives the symbol a numinous character, which creates heightened attention and expectation. The strong sense of expectation which is associated with the symbol charges it with psychic energy. It acquires a power of attraction and fascination which tempts man to 'keep on' with it. This playfully expectant handling leads to the true qualities of the object being gradually discovered, in other words the symbol grows slowly into true knowledge.[742] The unknown is made conscious and, with this, the symbol also loses its power of attraction and 'dies'. In this way the symbol constitutes a bridge between conscious and unconscious.

[740] Idem, 'Psychotherapists or the Clergy' (1932), *C.W.*11, §509.
[741] Idem, 'Psychology and Religion', ibid., §8.
[742] Idem, 'On Psychic Energy', *C.W.*8, §89 ff.

Jung assumes, however, that psychic energy is constant and inexhaustible. The energy that has been bound up in the symbol and is released when the symbol becomes 'knowledge' returns to its place of origin – the unconscious. During this phase the conscious feels disoriented and dispirited, but in the unconscious a new content constellates, eventually revealing itself in the form of a new symbol or at least as a new variation of the old one. This process is active both within individuals and within the framework of human history. Historically, however, it is a question of a very slow process that for the most part proceeds with the aid of almost imperceptible adjustments, with the exception of certain major breaks such as cultural crises and the collapse of civilizations.

Jung felt that a symbolic form, for example as in certain religious practices, is 'correct' so long as it represents a valid expression of the progressive direction of the unconscious situation. The symbol works when it expresses a continuing modification of the consciousness. But symbols and symbolic acts that have previously fulfilled a function can petrify into empty forms which can no longer express a living process. They have then forfeited their right to existence. Gradually there is either a shift in the symbol or, in drastic cases, it is completely abandoned and a new one is sought.

> Once metaphysical ideas have lost their capacity to recall and evoke the original experience they have not only become useless but prove to be actual impediments on the road to wider development. One clings to possessions that have once meant wealth; and the more ineffective, incomprehensible and lifeless they become the more obstinately people cling to them. (Naturally it is only sterile ideas that they cling to; living ideas have content and riches enough, so there is no need to cling to them.) Thus in the course of time the meaningful turns into the meaningless. This is unfortunately the fate of metaphysical ideas.[743]

Historical change thus takes place through the steady processing of unconscious material. Assuming alongside this process a spontaneous change or transformation of the unconscious and the archetypes, in other words a kind of autonomous evolution, appeared to Pauli quite superfluous.[744] He particularly opposed Jung's attempt to set up a kind of regular chronology and hierarchical order in the forms of manifestation of the archetypes, which would apply independently of the intervention of consciousness.[745] When in a conversation with Jung Pauli presented his objections and proposed that the archetypes and the unconscious can only be changed by observation, Jung

[743] Idem, 'Aion: Researches into the Phenomenology of the Self', *C.W.*9II, §65.

[744] Pauli, 'Background Physics', [Appendix 3], *PJL*.

[745] Jung assumes for example that one first encounters and processes one's shadow, then the contrasexual archetype anima/animus, in order then to be confronted with the archetype of the wise man or the wise woman and finally to meet the Self, which constitutes the archetype of wholeness. See for example Jung, 'Aion', *C.W.9 II*, §59.

agreed.[746] Jung had in several places put forward the view that the unconscious products always find expression in *relation* to the conscious attitude and that the relationship between conscious and unconscious therefore depends on a mutual interaction. On the other hand Jung asserted elsewhere that the archetypes and the collective unconscious can never be modified by the individual.[747] We thus find in Jung – not entirely unexpectedly – two (or more) conflicting viewpoints. On the one hand the unconscious is only changed when consciousness interacts with it, on the other hand there is a spontaneous maturing process in the unconscious which can break into consciousness and force it to change. In a third and most extreme version, Jung implies that the unconscious consists of eternal forces against which consciousness is more or less powerless. The explanation for this is that Jung postulates several layers of the unconscious, where the personal unconscious can be changed by conscious effort, while the deepest and most collective 'layers' cannot. This geological image of the unconscious does not rhyme well with his later non-visual and 'potential' unconscious.

Pauli did not find it difficult to accept that there might be a non-visual reality beyond consciousness, a reality which acts on consciousness and vice versa. But he definitely could not accept that this non-visual reality would in itself have some kind of consciousness, intention or 'conformity to plan'. It makes no difference whether one calls this reality God or the unconscious. Consciousness as a concept ought to be limited to man's ego-awareness. Jung on the other hand drew from his experience from the field of psychopathology. There it had been possible to show a number of psychic conditions where 'normal' consciousness had been suspended but where a pseudoconscious state had still prevailed. Ambulatory automatism, split personality (schizophrenia) etc. are phenomena which indicate that an unconscious condition continues to function as if it were conscious.[748] There is perception, thinking, feeling, expression of will and intent, just as if there was a subject. But there are also features which distinguish these quasi conscious states from consciousness, especially invariability and compulsiveness. A psychic state can only be *changed* with the help of consciousness. The unconscious states are also marked by the fact that they assume a mythological and numinous character, the further from consciousness they are.

[746] Pauli to Fierz, 12 Aug. 1948 [971], *PLC III*, 561.

[747] Jung, 'The Psychology of Transference', *C.W.*16, §354.

[748] Ambulatory automatism was the name given to the phenomena characterized by the fact that the subject performs actions, sometimes very advanced ones, in an 'unconscious' state. Examples of this are people who, while hysterical, under hypnosis or in other somnambulant states, perform acts of which they have no memory at all when they awaken (e. g. sleepwalkers). See Ellenberger, 124 f.

Jung thus thought that it is possible to speak of a scale of consciousness – a gradual transition from conscious to unconscious and from unconscious to conscious. No conscious content can be considered one hundred percent conscious. This leads to the paradoxical conclusion that there is no conscious content that is not to some extent also unconscious. At the same time the unconscious state contains consciousness-like phenomena, such as intention and expressions of will. As a consequence Jung did not want to link consciousness as phenomenon with ego consciousness alone, but spoke of different degrees of consciousness. These degrees of consciousness may be compared to different intensities of a light source or to land rising gradually from the water. An archaic, weak or infantile ego still has an archipelago character, whereas in a more mature ego the various contents are linked and form a mainland. Jung was therefore inclined to see the unconscious as consisting of a large number of islands of light which are gradually linked to give a steady glow. However this process has no final goal, one can never achieve a state of one hundred percent consciousness.[749] Jung therefore comes up with the hypothesis that the unconscious consists of a kind of multiple consciousness, analogous to scattered seeds or luminosities.

This kind of terminology made Pauli's hair stand on end. He could go so far as to accept the assumption of different transitions between conscious and unconscious, but, as concepts, consciousness stands for differentiation and the unconscious for lack of distinctiveness. With this strict terminological definition it naturally becomes a stark contradiction to speak of 'consciousness in the unconscious'.[750]

> In the meantime I have been thinking about the terminology 'multiple consciousness', and find it even less satisfactory than before: it seems to me *that the matter has not yet got much beyond the stage of 'if the ideas fail, a word comes opportunely into play'*. Not only the indisputable contradictio in adjecto 'unconscious consciousness' but also the term 'semi-consciousness' or 'partial consciousness' seems to me very unsatisfying. All I can see in the 'luminosities' is at most something like 'seeds of possible contents of ego consciousness' on the one hand, goal-orientation (if only in a limited degree), meaningfulness of the unconscious and possibly also physico-material processes on the other. From this one can perhaps speak of a 'multiple manifestation of a formal, ordering factor (the archetype)'.
>
> In my opinion however it is therefore inconsistent to assign 'consciousness' to the unconscious content, because then one must attribute even inanimate material objects with such (perhaps one can in some circumstances grant material bodies a 'latent psyche', but not 'consciousness'). I should therefore like to suggest *giving*

[749] Jung, 'On the Nature of the Psyche', *C.W.*8, §387.

[750] Pauli to Jung, 27 Feb. 1952 [55P], *PJL*, 79, footnote 10. The English translation here contains an error, corrected here to 'lack of distinctiveness', *Ununterschiedenheit* in German (*PJB*,81).

> *the concept of 'consciousness' only to such contents that are conceptions of a subject (the ego).* Any other course of action I consider scientifically inadmissible.
>
> Generally the limited utility of the concept 'consciousness' shows itself not only in psychology but also in biology: *it is impossible to state exactly which are the necessary and adequate characteristics of the observable phenomena that allow us to speak of the 'consciousness' of a specific object.* We consider ourselves reasonably certain about a pet, but does a plant have 'consciousness'? Or even a virus? It seems to me that here (so a fortiori in the case of 'luminosities') not only does the answer cease to be reasonable, but also the question. Evidently the progress of science must take such a course that the concept 'consciousness' will be replaced by a more general or better one.[751]

True to his epistemological style Pauli analysed the concept of consciousness and found it must be limited to human ego-consciousness. For all other 'consciousness-like' phenomena, such as animal behaviour, another concept is needed. Unlike the concept of 'multiple consciousness', Pauli found the concept 'multiple knowing' or 'multiple knowledge' (*Wissen*) more acceptable for the phenomena described by Jung.[752] Probably Jung allowed himself to be influenced by Pauli's criticism. After 1948 the term 'multiple consciousness' does not appear in Jung's texts. Instead we find the concept 'absolute knowledge', which is linked to the 'knowledge' or 'information' contained in the archetypes. This concept also forms a link to biology an ethology. From Hans Driesch, Jung had borrowed the idea that the living organism has been provided with an innate 'knowing' or an inherent 'knowledge'. The seemingly goal-oriented processes of nature and psyche caused Jung to assume the existence of an 'unconscious foreknowledge' which he describes as a kind of 'perceiving' of images or 'subjectless ›simulacra‹'.[753]

Pauli could accept the idea that the unconscious contains a kind of dark 'knowing' similar to the inherent navigational ability of migrating birds. On the other hand he had great difficulty in accepting concepts like 'foreknowledge', because this implies that everything is predetermined. Pauli did not wish to attribute a special intentionality to the unconscious but emphasized its dependence on being released by consciousness. Jung's assumption that the unconscious contains autonomous, regular processes that are *unrelated* to consciousness was epistemologically unacceptable to Pauli.[754] It reminded him of the antiquated viewpoint of classical physics that one can describe the objective order in the cosmos without taking the moment of observation

[751] Pauli to von Franz, 13 Jan. 1952 [1341], *PLC IV/1*. 'If the ideas fail, a word comes opportunely into play' is freely quoted from Goethe's Faust, Part I, student's room scene.

[752] Pauli to von Franz, end of 1951 [1334], *PLC IV/1*.

[753] Jung, 'Synchronicity: an Acausal Connecting Principle', *C.W.*8, §843, footnote 38, §931.

[754] Such a process is described in Jung's book *Aion* and is labelled 'Dynamics of the Self'

(the measuring process) into account. Pauli labelled this position 'the classical idea of the objective reality of the cosmos'. He compared Jung's way of describing the unconscious with the classical field concepts of physics and Maxwell's equations. Jung still used a mode of description which did not take the new epistemological situation revealed by quantum physics satisfactorily into account. Despite many advances in that direction he still had a tendency to treat the unconscious as a field that may be observed without considering the influence of the observation. Pauli considered that this state of affairs was fully comparable with the fact that in physics no satisfactory quantified field theory had been discovered, in other words a field theory which does justice to the quantum mechanical and the complementarity point of view. Yet again Pauli emphasized that psychology and physics were in that respect on the same epistemological level.[755]

The rejection of 'the classical idea of the objective reality in the cosmos' was one of the most important principles to Pauli. The influence of the process of observation on reality must form a central part of all scientific theory. This was the fundamental reason for Pauli's inability ever to accept various kinds of theory of so-called 'hidden variables', such as, for example, David Bohm's theory of the 'implicit order'. Bohm looked frenetically during the 1950s for support for his theories from Pauli, who naturally dismissed them because they are based on metaphysical assumptions of a causal order that cannot be confirmed by observation. Bohm then accused Pauli of 'positivism', because only a positivist prejudice could prevent anyone from accepting the excellence of Bohm's reasoning.[756] Pauli had of course more to go on than a positivist prejudice when he criticized Bohm's causalist theories.[757] Recently there have been a number of attempts to equate Bohm's theory of 'hidden variables' with Jung's theory of *unus mundus* (the unified world). These attempts seem to have entirely overlooked the fact that Bohm and Jung work with opposing worldviews.[758] Bohm's hidden order is causal because it assumes that all apparently acausal and alocal phenomena rest on a hidden, enfolded causality.[759] He therefore uses a purely reductionist model in which

[755] Pauli to Fierz, 3 Oct. 1951 [1286], *PLC IV/1*.

[756] 'What particularly irritates and annoys Herr Bohm in me is the fact that I declare that I am not a positivist. For he has nevertheless ›proved‹ that ›only positive prejudice‹ can resist the acceptance of his causalist doctrine of the hidden parameters'. Pauli to Fierz, 6 Jan. 1952, Laurikainen, 31, Cf [1337], *PLC IV/1*.

[757] See for example Wolfgang Pauli, 'Remarques sur le problème des paramètres cachés dans la mécanique quantique et sur la théorie de l'onde pilote', in: *Louis de Broglie, physicien et penseur* (Paris, 1953), 33–42.

[758] See for example Skogeman, 191; Peat, 168 f.

[759] See David Bohm, *Wholeness and the Implicate Order* (London, 1981), 161.

all diversity is referred back to an order 'where everything is interconnected' in a causal manner. Jung on the other hand had all his life been very sceptical of the idea of causality, which he admittedly considered essential to a certain type of knowledge, but even so, only one limited perspective among many others. Jung says in his *Mysterium Coniunctionis*:

> The causalism that underlies our scientific view of the world breaks everything down into individual processes [...] philosophically it has the disadvantage of breaking up, or obscuring, the universal interrelationship of events so that a recognition of the greater relationship, i. e. of the unity of the world, becomes more and more difficult.[760]

Pauli highlighted this passage in his own copy of the book.[761] Jung's conception of an 'underlying order' is as yet of unknown nature and only alluded to via the latest findings of modern physics and psychology. It is further based on the assumption that some kind of non-causal, shaping, self-organizing principle is at work in the universe.

[760] C.G.Jung, 'Mysterium Coniunctionis', *C.W.*14, §662.

[761] The book is in 'La Salle Pauli', CERN, Bellettrarisches No. 89, 2. (Cf C.G. Jung, 'Mysterium Coniunctionis', *C.W.*14, §662).

Incarnation and Quantum Physics

In a conversation with Pauli in June 1953 Jung had discussed among other things the concept of incarnation. This had made a deep impression on Pauli, who writes:

> I should like to thank you once again for the pleasant evening I spent with you. I shall give a lot of thought to many of the things you said, so that I can digest them properly. What made the deepest impression upon me was the central role played in your thinking by the concept of 'incarnation' as a scientific working hypothesis. This concept is of particular interest to me, first of all because it is supraconfessional ('Avatara' in India) and also because it expresses a psycho-physical unity. More and more I see the psycho-physical problem as the key to the overall spiritual situation of our age, and the gradual discovery of a new ('neutral') psycho-physical language of unity, whose function is symbolically to describe an invisible, potential form of reality that is only indirectly inferable through its effects, also seems to me an indispensable prerequisite for the emergence of the new ιεροςgγαμος predicted by you. I have also clearly seen how you have linked the concept of incarnation with ethics, which, moreover, just like Schopenhauer (in his work on the basis of morality), you have based on the identity of self and neighbour at deeper psychic levels ('what one does to others, one also does to oneself' etc.). Is it possible to define your point of view as *incarnatio continua*?[762]

The idea of incarnation is closely connected with Jung's view of the unconscious as the primeval rock of consciousness, which also contains the possible future lines of development of consciousness. Incarnation is tied up with the realization of a potentially existing reality and is therefore also linked with his concept of individuation, that is, the individual's realization of his own potential. The concept of incarnation is also related to the unique moment of creation and the advent of something new, especially a new or changed level of consciousness. Inspiration, creative impulses and sudden insights have their origins in the unconscious. But without consciousness, the products of the unconscious are amoral. A discerning consciousness, an ethical decision, is required in order to transform the products of the unconscious into cultural products. Similarly Jung sees the statements of interaction between God and man as symbolic expressions of an urge originating in the unconscious to be made conscious. '…since man knows himself only as an ego, and the self, as a totality, is indescribable and indistinguishable from a God-image, self-realization – to put it in religious or metaphysical terms – amounts to God's incarnation'.[763]

[762] Pauli to Jung, 17 May 1953 [56], *PJL*. ιερος γαμος = hieros gamos, the holy marriage. Symbol of reconciliation of opposites. Translation altered by the author.

[763] Jung, 'A Psychological Approach to the Trinity', *C.W.*11, §233. Cf also idem, 'Answer to Job' (1952), *C.W.*11, §553–758.

Pauli wanted to link the concept of incarnation with the, to him, crucial question of the psychophysical context. If incarnation means the realization of a potential reality, then the concept is closely associated with the fact that one is compelled to distinguish between 'the empirical phenomena' on the one hand and 'abstract, non-visual underlying reality' on the other. This applies in both quantum physics and depth psychology. Empirical reality is in both cases seen as a 'realization' of a potential in connection with a specific moment of interaction. As both disciplines – physics and psychology – have reached the same distinctions, the preconditions for a uniting of the old adversaries, materialism and idealism, are at hand. In this statement we can once again see Pauli searching for symmetry. Only on a phenomenological level can one distinguish between psyche and matter, the underlying non-visual reality may not be given any substantial epithet. Therefore one must say that 'reality in itself' is *symbolic*.[764]

[764] Pauli to Jung, 27 Feb. 1953 [58], *PJL*.

Science, Religion and Mysticism

> However there is in all people a third stage of religious experience, albeit only seldom a very pure one; I would call it cosmic religiosity. This is difficult to make clear to the person who possesses nothing of it, no human concept of God corresponds to it.
>
> The individual feels the nothingness of human wishes and purposes and the sublimity and wondrous order which is revealed in nature and in the world of ideas. He feels individual existence as a kind of prison and wishes to experience the wholeness of being as a uniform and meaningful one. [...]
>
> The religious geniuses of all times were distinguished by this cosmic religiosity, which knows no dogma and no God, conceived in the image of man. [...] It seems to me that the most important function of art and science is to arouse this feeling in those who are receptive and to keep it alive. [...] On the other hand I maintain that cosmic religiosity is the strongest and most noble driving force behind scientific research.[765]

These are Einstein's words. Here a form of religion is closely connected with science. The way Einstein contrasts the confinement in the chaotic world of phenomena and the longing for a liberating clear, elevated rational order was a *leitmotif* which Pauli considered fundamental to understanding the difference between the complementarity perspective of the Copenhagen School and the worldview of classical physics. The importance of this *leitmotif* went far beyond its role as a watershed between old and new physics; to Pauli this subject was central to his understanding of the history of Western ideas and the development of the history of science. The whole of this wide field of problems may be summarized in the symbolically loaded concept of *incarnation*.

Bohr emphasized the paradoxes of human consciousness and described the union of complementary opposites in a uniform, indivisible and non-visual 'hidden' reality, which can only be described with the aid of simile. For this reason, Bohr – like the whole Copenhagen School interpretation of quantum physics – has been linked with mysticism and oriental philosophy. Bohr himself refers to Lao Tse and oriental philosophy with respect to the epistemological problems that have been encountered in quantum physics:

[765] Albert Einstein, 'Religion und Wissenschaft' in *Mein Weltbild* (Berlin, 1955), 15. It may be interesting to note that Einstein, too, here mentions Schopenhauer as the vehicle of strong cosmic religious belief, namely the Buddhist.

> For a parallel to the lesson of atomic theory regarding the limited applicability of such customary idealisations, we must in fact turn to quite other branches of science, such as psychology, or even to that kind of epistemological problems with which already thinkers like Buddha and Lao Tse have been confronted, when trying to harmonize our position as spectators and actors in the great drama of existence.[766]

Maybe Bohr is thinking of the following passages from Lao Tse:

> The whole world recognizes the beautiful as the beautiful, yet this is only the ugly;
> the whole world recognizes the good as the good; yet this is only the bad.
> Thus Something and Nothing produce each other;
> The long and the short off-set each other;
> Note and sound harmonize with each other
> Before and after follow each other.[767]

Bohr underlines that it is not his intention to use these analogies to introduce a mysticism that is alien to the spirit of science. As with Sommerfeld, we find a distinction between different ways of using the term 'mysticism'. The mysticism with which Bohr could reconcile himself was a kind of nature-mysticism as expressed by great scientists who seek harmony in the diversity of nature. Nature-mysticism is contrasted with another kind of mysticism, which is basically a label for crude speculative thoughts and beliefs with no support in provable or observable phenomena. Oskar Klein attempts to describe the difference as follows:

> This trend of his [Bohr's] had nothing in common with the kind of mysticism, which fills the holes in our attempts towards a rational philosophy with mythological ideas taken literally – i. e. with quasirational concepts – but it may well be called religious, when *that* word is used in its essential meaning.[768]

What exactly is meant by 'mythological ideas taken literally' is not clear, but presumably Klein is here referring to spiritualism, astrology and occult doctrines. The word mysticism is often used pejoratively to indicate conceptions outside the scientifically accepted. Although the concept has room for a number of different meanings, mysticism is largely a contemplative philosophy that seeks what transcends and unifies the diversity of this world. In that sense there are a number of parallels between the scientist and the mystic. However the aim of the mystic is to come into direct personal contact with this unified reality, a reality that is often identified with God. It is a striving for ecstatic fusion with the cosmos and thus to suspend the difference between

[766] Bohr, 'Biology and Atomic Physics', *APHK*, 19–20.
[767] Lao Tzu, *Tao Te Ching*, II (Harmondsworth, 1963), 58.
[768] Klein, 'Glimpses of Niels Bohr as a Scientist and Thinker', *Niels Bohr: His Life and Work as Seen by His Friends and Colleagues*, ed. Stefan Rozental (Amsterdam, 1967), 75.

subject and object. This experience can only be described in paradoxes or in negating terms. The mystical experience is primarily a personal experience that does not need to be demonstrated or explained. In that sense it is entirely unlike science.

The arguments put forward to classify Bohr as a positivist as well as a mystic often coincide. As evidence of Bohr's positivism is taken his refusal to answer the question about the true nature of atomic systems. Instead one has to be content with correlations between experimental preparations and observable measurement results.[769] It is Bohr's emphasis on the boundaries of our epistemological capacity that make him a positivist in the eyes of the critics. The fact that we can know nothing of the nature of reality beyond the phenomena, beyond the verifiable, is a typical instrumental and positivist attitude, and has been called the attitude of *resignation*.

When Hans Peter Dürr urges that the new physics has drawn closer to the 'transcendental' or 'mystical', he produces the following argument:

> If it had been originally assumed that in the course of the progress of the sciences the 'transcendental' would be increasingly suppressed, because in the last resort everything would be capable of rational explanation, it now turned out, on the contrary, that the material world which is so tangible to us increasingly proves to be apparition and dissolves into a reality where it is no longer things and matter, but form and shape, which dominate. [–––]
>
> Quantum physics made it clear again that our scientific experience, our knowledge of the world, does not represent the 'inherent' and 'ultimate' reality, whatever one wishes that to mean.[770]

Here exactly the same argument recurs. It is the impossibility of knowing anything about the 'true nature' of reality that makes new physics the spokesman for the transcendental. In religion and mysticism it is also found that we cannot know anything of God's true nature and that we can only speak of our experience in symbols and similes. Bohr drew parallels with oriental philosophy and mysticism for the same reason as he drew parallels with psychology and biology. He wished to show that the conditions of our knowledge are a general human phenomenon, which recurs in all attempts to understand the world and that for that reason we can find them in the philosophical foundations of different cultures.[771]

Pauli had a different attitude to mysticism. Pauli clarified his position in a long letter to Niels Bohr in 1950. In it he contrasts Bohr's attitude to Chinese philosophy with his own. He points out that the idea, which Bohr has

[769] See, e. g., Nordin, 98.
[770] Hans Peter Dürr, *Physik und Transzendenz* (Bern, 1988), 13.
[771] Bohr to Pauli, 2 March 1955 [2035], *PLC IV/3*.

expressed in logical terms in his complementarity principle, is something that has been described by the world's mystics throughout the ages. What Bohr expresses is of course the idea that apparently contradictory and paradoxical phenomena together form a more complete picture of an underlying, non-visual reality. This non-visual reality has always been the object of the mystics, but with the difference that they have described it from the point of view of a *strong personal experience*. To Pauli it becomes important to emphasize that the mystic describes this experience as one where the ego becomes unimportant in favour of a more generally valid spiritual or 'psychic' background in which personal conflicts are suspended. Pauli claims that it is quite possible to have such an experience without belief in a God. He mentions Buddha and Lao Tse as examples. Previous mystics, such as Meister Eckhart, instead explain God as dependent on the human soul. Yet others allow God to coincide with 'nothingness', as does Plotinus, for whom 'the One' *(to en)* can only be described with the aid of negatives. Lao Tse calls his non-visual reality Tao – something that neither harbours feelings nor is good or evil. But Tao is also a condition where the ego, with its trivial desires and values, submits to a cosmic order.[772] This condition describes a mystical experience, an experience which Pauli contrasts with rational-logical analysis.[773]

Although Pauli repeatedly brought up the question of the role of mysticism and religion in relation to science in his letters to Bohr, Bohr often replied rather evasively, saying, 'that they understood each other so well'.[774] The last time they discussed the subject was in 1955. This was after Pauli sent comments on and criticism of Bohr's article 'The Unity of Knowledge'. On this occasion Bohr said that, contrary to what many of his friends appeared to think, he had always sought scientific inspiration in epistemology and not in mysticism.[775] Pauli replied that for his part he could very well find things in mysticism that might inspire him in science, although this was always counterbalanced by his immediate sense of mathematics. In addition he noted that the question of 'unity' has always been a main theme of the mystics.[776] Bohr countered by asserting that in the last resort it was only a question of occasional differences in their choice of words. Mysticism or logical systematism – they both tried to illuminate the same basic problem from their respective viewpoints.[777] Perhaps Bohr wished primarily to underline the need for balance between two

[772] Lao Tzu, *Tao Te Ching*, II (Harmondsworth, 1963), No. V, XVI, XXV, 61, 82, 72.
[773] Pauli to Bohr, 3 Oct. 1950 [1158], *PLC IV/1*.
[774] Bohr to Pauli, 23 Dec. 1950 [1187], ibid.
[775] Bohr to Pauli, 2 Mar. 1955 [2035], *PLC IV/3*.
[776] Pauli to Bohr, 11 Mar. 1955 [2041], *PLC IV/3*.
[777] Bohr to Pauli, 25 Mar. 1955 [2047], *PLC IV/3*.

different ways of working: analysis and synthesis. In a lecture which he had given in 1938 he had stressed that only such a balance could save us from the extreme positions of materialism and mysticism.[778] In a manuscript written in 1954 he developed this idea by stating that materialism and spiritualism are simply two sides of the same coin. This was of course what Bohr had always said: just as wave and particle are one-sided and mutually exclusive descriptions of physical reality, so they are at the same time both necessary descriptions of an essentially inaccessible reality. This viewpoint was also reflected in Bohr's view of the concept of God. He is said to have stated that the assertion 'there is a God' and 'there is no God' are both pronouncements of great wisdom and truth.[779]

Pauli was careful to emphasize that one must not have preconceived ideas about how the cosmic order is arranged. We must not imagine that it conforms to our categories and conceptions like, for instance, classical causality. Pauli wanted here to make use of the insight of quantum physics. The statistical character of natural laws already was an answer to the question about the nature of cosmic order – an answer given to us by nature herself. Einstein could not accept this 'open' order – an order that eludes our rational categories. This also represents the fundamental difference between Pauli and Einstein's view of the cosmos. We may perhaps find the explanation of this difference in Einstein's emphasis on the identity of nature with the world of pure thought. It is with the aid of thought alone that we can grasp the cosmic order. For Einstein this world of pure thought stands in sharp contrast to the confinement of everyday life and complicated human relationships. It even seems that Einstein took refuge in science so as to escape from social intercourse. Pauli, on the other hand, battled with the question of how feeling values and the irrational might be able to find an objective place in the description of nature – a question that he thought had been neglected by both physicists themselves and physics as a science.[780] But despite Pauli's assertion of the importance of feeling-values and ethics we find that he in reality often emphasizes that human values such as good and evil can never be applied to the ultimate reality of the cosmic order. On the contrary he feels most at home with positions that exclude value judgements, as for instance when he points out the sympathetic features of mysticism and also when he explains his own god-image.[781]

[778] Bohr, 'Analysis and Synthesis in Science', 28.
[779] Honner, 179 ff.
[780] Pauli to von Franz, 22 Feb. 1951 [1205], *PLC IV/1*.
[781] 'Tao – something that neither harbours feelings nor is good or evil.[…] a condition where the

'Sometimes I think that I will only be able to reach the longed-for *coniunctio* if I could say something or formulate something that would greatly shock both the representatives of conventional religion and the representatives of conventional science. But I do not yet know exactly what it is', ponders Pauli.[782] We have previously seen how Pauli was unable to accept a simple division between scientific knowledge and religious conviction. He was inclined instead to see the two as different phases of the same epistemological process. One way of seeing this relationship is to regard the religious or mystical side as a preliminary stage of what later becomes an increasingly scientifically differentiated concept. From this perspective the religious phase is linked with the feeling of evidence, while the scientific phase is linked to proving or revising this feeling. Later in life Pauli sought a more symmetrical picture of the relationship between religion and science, one which does not reduce religion to a preliminary stage of science. Pauli had already written to Markus Fierz in 1948 that science and religion must always be linked to one another. But he definitely did not mean that religion was to be incorporated in science or that science was to be a part of religion. Instead they had both to be integrated in a bigger picture.[783] The question was how one should formulate such a unified way of looking at the matter.

In his paper *Science and Western Thought* which was given in the spring of 1955, Pauli defined the difference between religion and science as a difference between *kinds* of knowledge. Religion or 'knowledge of salvation' (*Heilserkenntnis*) asks not why, but how. *How* can man avoid suffering and evil in this terrible world? *How* is man to proceed in order to see that the chaos and suffering of this world is an illusion and *how* is one to see the unity – God, Brahman, the One – beyond multiplicity? On the other hand it is scientific-occidental, even 'Greek', to wonder: *Why* is 'the One' mirrored in the Many? What is it that mirrors, and what is mirrored? *Why* did multiplicity arise from the One? What originates the illusion? Pauli felt that it was the destiny of the West to try to unite these two basic attitudes. The critically rational which gives demonstrable answers to how the world and we are constructed – i. e.

ego, with its trivial desires and values, submits to a cosmic order.' Pauli to Bohr, 3 Oct. 1950 [1158], *PLC IV/1*; 'The assumption of an extra-human (divine) consciousness leads to the most absurd illusory problems of good and evil' [–––] In Chapter 5 of the Taoteking (›Heaven and earth are ruthless, and treat the myriad creatures as straw dogs…‹) everything necessary on this subject seems (in a few lines) to be said. Pauli to Jaffé, 28 Nov. 1950 [1172], *PLC IV/1*; 'I have Protestant Christian friends who also happily adopt the view of ›negative theology‹… [–––] Personally I get on best with this sect of the Protestants.' Pauli to Jung, 27 Feb. 1952 [55P], *PJL*, 'The ethical point of view is necessary for man but on ethical grounds alone the ultimate reality of the ›void‹ (= the 'one') seems to me not to be attainable.' Pauli to Jaffé, 25 Sep. 1951 [1284], *PLC IV/1*.

[782] Pauli to Fierz, 19 Jan. 1953, [1507, attachment], *PLC IV/2*, Laurikainen, 90.

[783] Pauli to Fierz, 12 Aug. 1948 [971], *PLC III*, 559.

facts – and the mystically irrational which gives us an *attitude* to the world – wholeness, meaning and redemption. Each position will always carry the other already within itself as the germ of its opposite and a dialectic process arises between them. This description naturally calls forth the image of the taoist symbol *Tai chi*. The most important message to Pauli is once again the symmetrical relationship: we cannot give up our critical consciousness, but nor can we renounce our longing to immerse and extinguish ourselves in a greater experience of totality. By letting the tension of opposition between these two continue, we also realize that both on the road to knowledge and on the road to redemption we are dependent on factors which are beyond our control and which in religious language are always called 'grace'.[784]

According to Pauli at least two historical currents can be identified which seek to unite the mystical and the scientific approach. One is the Pythagorean-Platonic, which culminated in the classical scientific worldview. It was incorporated in both Christianity and the dawning natural philosophy. But from the seventeenth century onwards, the critically rational part deviates with increasing speed from the mystical, disciplinary boundaries are set up and the religious view of the world is separated from the rationally scientific. The second current which has sought to achieve a synthesis between the route to salvation and scientific knowledge is the hermetic-alchemic. This current has its roots way back in pre-Christian doctrines; it expanded in the late classical period after the appearance of the *Corpus Hermeticum* (whose contents are attributed to a certain mystic Hermes Trismegistus), was fertilized by Arab sources and then ran through the whole of the Middle Ages to reach its peak in the sixteenth century. The synthesis that was sought proved, however, to stand on too narrow a base and towards the end of the seventeenth century it disintegrated into its constituent pieces and was divided into scientific chemistry on the one hand and a mysticism free from all material processes, represented by, for example, Jacob Boehme.[785] Pauli emphasized that alchemy seems to have maintained a certain symmetry between spirit and matter, unlike the more spiritual school of Neoplatonism which identified matter with evil. According to the alchemic conception there resides in matter a spirit which awaits deliverance. The work of the alchemist first involves untying the old bands between body, soul and spirit to find a higher union of all three. The body is never excluded, the body is made spirit, and spirit is made body. But above all the alchemist is always included in the processes of nature, as the more or less real chemical processes in the retort are in a mystical way

[784] Pauli, 'Science and Western Thought', *WPP*, 139f.
[785] Ibid., 145.

identified with his own mental processes, which are also designated by the same terms. *Spiritus* is identified with the material result of a process of distillation, as well as with that which man has always identified with the most agile and volatile substance in his own being: the spirit. In the process both body and soul are dissolved, to be reunited in a more integrated form. Because of the correspondence which is assumed to exist between macrocosm and microcosm, the deliverance of matter leads at the same time to man's own salvation. Despite the fact that the work of delivery rests in the hands of experimenting man, it can only succeed *Deo concedente* – God willing. A wish to unite mind and matter or a tendency to see them as two sides of the same thing had existed in the alchemist tradition. Therefore one may perhaps also find clues there to how in our time we might resolve our divided worldview.

In the modern world, the symmetry between the internal and the external, between mind and matter, is disturbed. This tension of opposites is projected onto the political arena, in a search to eliminate 'the other'. Pauli saw the increased tension of his time between political blocs and the accompanying rearmament as a result of this. By way of compensation, therefore, strong internal images with the *Coniunctio* motif arise in modern man.

> The *symmetry* from within and without is in my opinion *de facto disturbed* in our time, this is a *historical* situation! Outside there *is* only a sharpening of the antithesis (*world armament* in my immediate vicinity here, for example. – One could say 'I would rather learn to spit farther than the other, otherwise the other will certainly have the idea of spitting in my soup *first*.' You can also substitute another verb for 'spit'. *That* is what it looks like on the outside.) Therefore I spoke of '*internal* images, fantasies or ideas,' which are compensatory with relation to the *external* situation.[786]

Kepler retained a mystic element in the science of his time, but from modern science this element, this *value*, has totally disappeared. Pauli asks: Where can it have gone? There can only be one solution to the problem: science must also include 'knowledge of salvation'. This cannot be done as long as it desperately holds man *outside* with the ideal of a detached observer. Scientific work is not to be replaced by some kind of contemplative faith or 'mystic experience of unity'. '*… in the age of science, i. e. today, such a thing can hardly come about as it did in the past*!' says Pauli.[787] Nor must we make the mistake of the alchemists and believe that the psychophysically unified worldview and the neutral language can be based on naively perceived, visible reality. The two realities can only unite on an abstract, symbolic level. The weakness of

[786] Pauli to Fierz, 21 Feb. 1956, [2240], *PLC IV/3*, written from Princeton.
[787] Ibid.

the alchemists was their inability to distinguish between the concrete and the symbolic. Their unified vision was based on too great a degree of *projection* of the psychic reality onto matter, which led to an illusory perception of the properties of concrete matter. Although the experimentation of the alchemists led them to certain empirical discoveries concerning chemical substances, their treatises contained an illumination of the structure of the psyche rather than of matter. According to Jung, the alchemists were – quite accidentally – the first to discover and describe the processes of depth psychology.

A modern unified vision must, says Pauli, build on an equal measure of *introjection* of true knowledge of matter into the psyche, as well as insight into the dynamics of psychic imagery. Only in this way can a meeting between psychic and physical reality take place. By studying both the phenomenology of the psyche and physical phenomenology it is possible to obtain a clearer picture of what really unites psyche and matter. What Pauli searches for is a cooperation of the disciplines of physics and psychology – a psychology that investigates the cognitive processes of man and a physics that includes knowledge of the observer. Only in that way can we maybe come closer to where the 'cut' between observer and observed can be positioned. Pauli was convinced, this time wholly in agreement with the alchemists, that the 'knowledge of salvation' of modern times must presuppose *work* which leads to knowledge and thus to deliverance. This applies to work with both matter and psyche. Work with matter has the aim both of gaining knowledge and of improving man's concrete living conditions. In the same way psychology gives man knowledge of himself, which is a precondition of achieving a meaningful life. What is important to recognize is that religious search and the scientific quest for knowledge have the same incentive.[788] Without this insight an unrewarding antagonism arises between religion and science, while at the same time the scientist remains blind to the motives that guide him in his search for knowledge. Science and religion then become typical hostile brothers, seeing the mote in the other's eye but not the beam in their own. The cultivated side of religious feeling consists of open humility, whereas its regressive side consists of dogmatic fanaticism – components which we find to an equal extent in science and religion.

[788] Pauli to Fierz, 27 Jan. 1956, [2231], *PLC IV/3*.

Parmenides v. Heraclitus, Einstein v. Bohr

The psychology of scientific conceptualization, or 'background physics', was to Pauli a field that could illuminate the psychological processes and structures underlying the theory of natural philosophy. With the aid of such a perspective, it was easier to understand how different thinkers could on the basis of the same factual material have arrived at different, sometimes even contradictory, theories. As a tool to be used in studying the history of science it could bring out the different mental or archetypal pictures that form a basis for different interpretation or structuring of facts. This had been one of the purposes of Pauli's work on Kepler, where he wanted to show that Kepler worked from a *trinitarian* model, while the hermetic Fludd proceeded from the number four. Pauli wished however also to apply the same approach to the latter-day conflict between Einstein and Bohr.

In the course of his work on Kepler, Pauli had also immersed himself in Neoplatonism and there come across Plotinus. He was immediately struck by the fact that Plotinus was an upholder of the theory of *privatio boni*. But it was more particularly Plotinus' linking of matter ($\upsilon\lambda\eta$) with evil and non-being that aroused Pauli's interest. Jung had asserted in his writings that the *privatio boni* theory derived from early Christianity. Jung's version was that the doctrine went back to Origen, Basil and Augustine.[789] This Christian idea must then have influenced the Neoplatonists. However Pauli nursed the suspicion that the *privatio* theory dated back to earlier, pre-Christian sources and that it was these that had inspired Plotinus and the Neoplatonists. It was then via the Neoplatonists that the idea had reached Christianity.

Pauli wrote a letter to the Plotinus specialist H.R. Schwyzer to clarify the matter. He later enlightens Jung on the results. From Schwyzer he had indeed received confirmation that the discussion of the nature of matter went back to the polemics of Aristotle and Parmenides. Parmenides asserted that matter should be regarded as the 'lack' of form and therefore as non-being.[790] Later the Neoplatonists equated non-being with evil. This confirmed Pauli's suspicion that it was the equation of matter and 'lack' in antiquity that formed

[789] Jung, 'Aion', *C.W.9 II*, §74–91.
[790] *Steresis* ($\sigma\tau\varepsilon\rho\eta\sigma\iota\varsigma$) in Greek, *privatio* in Latin.

the natural philosophical origin of the later theological Christian theory of *privatio boni*.[791]

To Pauli it was interesting to find a predecessor in natural philosophy to the theological and psychological problems which so much engaged Jung. He was especially interested in the mentality which lay behind connecting the One, the Good, Being and Spirit (form). Such a position excludes 'the opposite other' and explains it as a 'lack'. Pauli labelled it a 'hole theory' with reference to Dirac's theory of anti-matter.[792] We find such a static worldview in Parmenides, which stands in stark contrast to the worldview of Heraclitus, in which the tug of war between opposing pairs produces a permanent 'becoming' – evolution and development. Becoming has no place in Parmenides, for that which does not already exist, can never come into being. Pauli regards these questions from his perspective of symmetry. Heraclitus is symmetrical, he treats the opposites equally, whereas Parmenides is asymmetrical because he emphasizes only 'being'. Pauli associates Parmenides' worldview – which is compared to a stationary sphere – with a longing for freedom from conflict. The same is true of the Neoplatonist devaluation of matter as evil: such a conception represents nothing more than rationalized flight from reality. He found it remarkable that it was those 'who denied becoming', with their static and unchanging ideal world, who gradually came to identify matter and evil as simply a 'lack'.

The Neoplatonists describe the captivity of the human soul in matter. In its original state the soul was as perfect as God, but it has fallen and been sullied (darkened) by matter. Man's task is to free himself and return to God, the perfect. His sojourn in matter which was caused by unfortunate circumstances adds nothing of value and is considered more or less an unnecessary mistake or a purely illusory existence. Earthly life is therefore quite meaningless.[793]

> The Platonist *rises* 'anagogically' [...]: things return to God, from whom they once emanated as 'theophanies' (why?) and all is as in the beginning. The hermetic, however, *descends* into matter, in order to redeem this matter (not primarily man), by liberating the anima mundi sleeping within. As the 'result of the work' arises the 'filius philosophorum', the stone, which is a 'higher' or 'sublimated' form of prima materia (albeit already latently present in it from the beginning).[794]

Pauli contrasts this depreciatory view of 'incarnation', of matter and suffering, with the alchemists' picture of the world. There the liberation of the soul is regarded as a task which *presupposes* its captivity as an original condition. The

[791] Pauli to H.R. Schwyzer, 27 Jan. 1952 & 3 Feb. 1952 [Appendix 4], *PJL*, 197 f.
[792] See *PLC IV/1*, 373.
[793] Pauli to Fierz, 12 Aug. 1948 [971], *PLC III*, 559.
[794] Pauli to Panofsky, 21 Dec. 1949 [1065], *PLC III*, 723, footnote.

actual work of freeing the soul is a process which *includes* work on matter and the final goal is a state which transcends the original one. Here earthly life is seen as a precondition of attainment of the final goal, whereas in Neoplatonism it seems that existence is a parenthesis which does not add anything to what was there from the start. For the alchemists, the final goal is a *coniunctio*, a unification of opposites which forms something third and unique.[795]

Pauli notes with pleasure that at last one begins to discern the end of the Western tradition which has brought out only one side of reality. This unbalanced 'either-or' perspective is now beginning to be replaced by a broader thinking on 'both-and' lines. We find the seeds of this 'new' thinking in the hermetic tradition and in oriental philosophy. Both Jung and Bohr refer to the wisdom of the East when they seek parallels with their own position.[796] They both try to deal with opposing pairs in a more symmetrical manner, the result being that they are coming closer to a worldview which includes irreversibility and a dynamic element of becoming.[797]

Pauli writes to Jung that what is so fundamentally new about Bohr's position is that he – and with him modern physics – has for the first time broken with the Platonic worldview which, according to Pauli, has until the advent of quantum physics formed the foundations of Western science.[798] Here the rational is identified with the Good and with 'Being' while Non-being corresponds to what one cannot capture in rational terms. Non-being, *privatio* or *steresis*, is thus synonymous with what we would call the irrational and the obscure. Plato defines matter as the distinction between the bodies apprehended by the senses and the ideal geometrical object. What is good in the bodies is what is comprehensible, i. e. that which can be captured in geometrical-mathematical concepts. The rest is matter, which is thus defined as incomprehensible. Matter is perceived as something female and passive, which receives geometrical forms or ideas. There is also a slightly more 'active' description of matter in Plato, where it is defined as the *nurse* of ideas (or form), in other words as the precondition of realization – or incarnation – of form in the material world. Aristotle gave matter a little more credit and acknowledged it as 'potential being'. Euclidean geometry, on the other hand, saw matter solely as a passive recipient of the actually 'existing' geometrical idea. In consequence of this, pure matter is seen simply as a 'lack of ideas' and

[795] Pauli to Fierz., 9 Mar. 1948 [941], ibid., 514.
[796] C.G.Jung, 'Psychological Commentary on ›The Tibetan Book of the Dead‹' (1935/1953), *C.W.*11, §833; Bohr, 'Biology and Atomic Physics', *APHK*, 19–20.
[797] Pauli to Jung, 27 Feb. 1952 [55P], *PJL*.
[798] Pauli to Jung, 27 February 1953 [58P], *PJL*.

furthermore as dark and evil (and female!).[799] As Being has been identified with the preexistent eternal forms, science has had trouble describing the dynamically changing aspects of the world. With quantum mechanics, this has changed, and we are approaching a 'theory of becoming'. In this connection Pauli mentions how Bohr taught him at an early stage to think in paradoxes:

> The complementary characteristics of the electron (and the atom)(wave and particle) are in fact 'potential being,' but one of them is always 'actual nonbeing'. That is why one can say that science, being no longer classical, is for the first time a genuine theory of becoming and no longer Platonic. This accords well with the fact that the man who is for me the most prominent representative of modern physics, Mr. *Bohr*, is, in my opinion, the only truly non-Platonic thinker: even in the early 20s (*before* the establishment of present-day wave mechanics) he demonstrated to me the pair of opposites 'Clarity-Truth' and taught me that every true philosophy must actually start off with a *paradox*. He was and is (unlike Plato) a *dekranos kat exochen*, a master of antinomic thinking.[800]

The absolute, sublime and rational world of ideas, often represented in science by a uniform, objective and logically coherent theory, is a construction which in its perfection is often too far removed from the complexity of reality. The belief that a theory corresponds to an objective reality is according to Jung a residue of the primitive thinking of *participation mystique*. It implies that the individual is unable to distinguish between himself and the object, and believes himself to be in a direct relationship with the latter. This may be described as a partial identity with the object, which gives the object magical or absolute influence over the subject, as for instance in the belief that a magic amulet influences a person's health and vitality. This identity is supposed to be a residue of a primeval state where subject and object are not yet separated. With the increase of consciousness the subject realizes that this experience of identity rests on projection.[801] In the same way the belief in the absolute objectivity of a theory is an inability to distinguish between the aptitude and needs of the human psyche and actual reality. There is not so much a difference in kind as a difference in degree between the native's belief in the magical force of the amulet and the physicist's belief in the absolute objectivity of a unified field theory. In both cases the characteristics attributed to the external object (the amulet, the universe) also reflect psychic qualities in man. This does not mean that we can never know anything about external reality, just that we tend to overlook the psychic factor in all observation and theory formulation.

[799] Pauli, 'Science and Western Thought', *WPP*, 141–43.
[800] Pauli to Jung, 27 February 1953 [58P], *PJL*, 93f.
[801] Jung, 'Concerning the Archetypes with Special Reference to the Anima Concept', *C.W.9I*, §121.

Pauli also used this psychological perspective when assessing his colleagues in science. For instance, he felt that he had fully understood Einstein's position, which he labelled *metaphysical realism*.[802] What characterizes this viewpoint is the fact that a physical system can only be regarded as objective if the positions of the objects are always exactly determinable and in no way depend on what experimental device is used to observe them. Consequently, what chiefly annoyed Einstein in quantum physics was '*… that the state of a system is defined only by specification of an experimental arrangement.*'[803] Einstein spoke therefore of the 'objective real state', a state that exists regardless of observation. From Einstein's point of view the statistical description of reality in quantum mechanics must be incomplete, because it makes it impossible to determine the real state of an object.

This 'realistic' philosophy differs sharply from a phenomenological position. Einstein's worldview was not 'the observer's' but assumed the existence of certain exactly defined relationships which exist whether we observe them or not. In Pauli's view, such a position is dogmatic and metaphysical because it is based on a philosophical prejudice and hence not influenced by facts.[804] Pauli called Einstein a 'Spinozist', because Einstein had told him that his image of God largely agreed with Spinoza's.[805] Spinoza saw all existence as a single systematic unit which he called God or nature. This unit is governed by eternal and logically necessary laws. Many people have said that Einstein's 'Spinozism' amounted to the belief in a determinist world.[806] This was also stated by Max Born. In 1954 he corresponded with Einstein on an article that Einstein had written for an edition of 'Scientific Papers' on the occasion of Born's retirement. As a result of this, Born had written a manuscript in which he argued that Einstein's view of the world was deterministic. Einstein opposed this labelling and finally Pauli got involved in the argument. Born describes the incident as follows:

> The preceding letters show how two intelligent people can misunderstand each other while discussing concrete problems. Each was convinced that he was right

[802] Pauli's understanding of Einstein's philosophical position is discussed by, among others, Max Born, in *The Born-Einstein Letters*, 188–189.

[803] Pauli to Born, 3 Mar. 1954, *The Born-Einstein Letters*, 218.

[804] 'philosophical prejudice', Pauli to Born, 31 Mar. 1954, *The Born-Einstein Letters*, 221; 'realistisches Dogma' and 'realistische Metaphysik' see Pauli to Heisenberg, 5 Jul. 1954 [1842], *PLC IV/2*

[805] Pauli to von Franz, 22 Feb. 1951 [1205], *PLC IV/1*.

[806] See for example Laurikainen, 94–95. Laurikainen also claims that Pauli was of the opinion that Einstein held a determinist worldview. See also Ilya Prigogine & Isabelle Stengers, *Order Out of Chaos* (London, 1984), 310; Abraham Pais, *Einstein Lived Here* (New York, 1994), 129; Feuer, 146; Honner, 108.

> and the other wrong. This happened because each proceeded from a different point of view, which he regarded as incontestable, and was thereby prevented from accepting that of the other.
>
> In this situation it was fortunate that a third person intervened and acted as intermediary: Wolfgang Pauli. [–––] He became a close friend of Einstein's and regarded himself, probably with some justification, as the designated 'successor' in theoretical physics.[807]

Born describes how Pauli entered the conflict between Born and Einstein to examine the differences between their epistemological positions. Pauli had visited Einstein at Princeton in the spring of 1954 and so heard of their ongoing discussion. As these questions interested Pauli, he asked to hear Born's version of the disagreement.[808] When he had finished reading Born's manuscript he wrote back and told him that he was unable to recognize Einstein from his description. As Pauli saw it, Born had constructed a mock Einstein which he then refuted with great ceremony and circumstance. This particularly applied to the label 'determinism'. The correct designation of Einstein's starting point should be metaphysical realism.[809]

> In particular, Einstein does not consider the concept of 'determinism' to be as fundamental as it is frequently held to be (as he told me emphatically many times), and he denied energetically that he had ever put up a postulate such as (your letter, para. 3): 'the sequence of such conditions must also be objective and real, that is, automatic, machine-like, deterministic'. In the same way, he *disputes* that he uses as criterion for the admissibility of a theory the question: 'Is it rigorously deterministic?' Einstein's point of departure is 'realistic' rather than 'deterministic', which means that his philosophical prejudice is a different one.[810]

What annoyed Einstein was that 'In quantum physics the state of the physical system depends on how one sees it', as he put it. The fact that this would be just as true of macrophysics as of microphysics does not fit in well with Einstein's worldview.[811]

Pauli asserted that Einstein's Spinozism thus lay on a level other than determinism. It is the wish to be able to understand the context of everything on an objective level – to be able to see reality as it really is. According to Spinoza there is no difference between the thought and the objects. Every conception has an object and they are different aspects of the same substance. For that reason man can understand reality by thought. There is no dualism

[807] *The Born-Einstein Letters*, 217.
[808] Pauli to Born, 3 Mar. 1954, ibid., 218.
[809] Pauli to Born, 15 Apr. 1954, ibid., 224–225.
[810] Pauli to Born, 31 Mar. 1954, ibid., 221.
[811] Pauli to Born, 3 Mar. 1954, ibid., 218; Pauli to Born, 15 Apr. 1954, ibid., 226.

between the observer and the observed, between subject and object. Truth is quite simply a direct insight into logically necessary connections between the characteristics of things. All things are, moreover, different aspects of the same underlying substance, which is by nature infinite and rationally ordered. Einstein's Spinozism is primarily reflected in his wish to get beyond the manifold nature of the external world and to reach a timeless, elevated rational world. He had always regarded the 'phenomenological' viewpoint – the one who led him to the theory of relativity – as a necessary evil, but an evil nevertheless.[812] On a phenomenological level he might have accepted irreversibility – a before and after in physics – , but in his letter to Michael Besso one clearly sees that this does not really reflect his true view of physical reality.[813] How then could he accept a physics that introduces irreversibility on such a fundamental level as in the very definition of the physical phenomenon, the basic building blocks of physics? In Einstein's opinion irreversibility has to be considered an illusion created by 'improbable' initial conditions. Following the death of Besso, Einstein wrote to his sister:

> Now he [Besso], too, has just preceded me in his departure from this strange world. This means nothing. To us believing physicists the separation of past, present and future has only the significance of an illusion, albeit a stubborn one.[814]

This was not a 'late in life' viewpoint of Einstein's. His first theoretical attempt in 1917 to construct a cosmic model based on general relativity presented a static, timeless picture of the universe – Spinoza's vision in physical form.[815]

The fundamentally new element in the Copenhagen interpretation of quantum mechanics is the introduction of observation as *activity*. Man can no longer observe the structure of existence; his observations constitute an active intervention in nature which unpredictably changes what is being observed. Observation constitutes an irrational intervention in a postulated continuity. In a Platonic world there are only causes which have effect, but these causes cannot be acted upon in return. Modern physics, on the other hand, must include the *interaction* of man and cosmos. It is this irrationality of observation that prevents the wavefunction (Ψ) from remaining 'Platonic', i. e. in 'metaphysical space'. In this way the 'reality' of the wave function becomes 'symbolic', which is quite different from 'crystal clear', much to the dismay of the Spinozist (Einstein), the Cartesian (de Broglie) and the in-

[812] Cf Einstein to Besso, 8 Aug. 1938, [126. I] *Correspondance*, 321. 'You know of course that I have never believed in fundamentally statistical basic laws of physics…'

[813] Einstein to Besso, 20 Aug. 1918, [46] (E.37); Einstein to Besso, 22 Sep. 1953, [200] (E.95), ibid., 134, 507.

[814] Einstein to the son and sister of Besso, 21 Mar. 1955, [215](E.98), ibid., 538.

[815] Prigogine & Stengers, 215.

tellectual aesthete (Schrödinger), concludes Pauli.[816] Pauli believed that the chief difference between him and the 'opposition' – i. e. those who considered quantum mechanics incomplete and positivistic – was not that he wanted to keep to the 'phenomena', while the others wanted to proceed from their metaphysical ideas. It was rather that the two camps had different *mental images*. The difference between him and the 'opposition' was largely that they – in a one-sided manner – had chosen 'the field picture' at the expense of the particle perspective. Pauli and the Copenhagen School, on the other hand, worked with both field and particle. Symbolically expressed, both have totally opposed approaches to a very old and fundamental problem – the relationship between continuity and discontinuity, rationality and irrationality, and, ultimately, between spirit and matter. For it is the ideal field theory, this beautiful unified intellectual construction, which is opposed to the expression of matter in the form of the defined unit 'quanta'.[817] The vital point is that the Copenhagen perspective tries to integrate and unite these opposing pairs, while 'the opposition' wants to make things easy by favouring only the one perspective that simplifies, rationalizes and beautifies. Heraclitus against Parmenides in new form. Pauli believed that Parmenides' beautiful resting cosmic sphere expressed a flight from reality. He also called the striving of Einstein, Schrödinger and others back to a classical worldview 'regressive hopes'.[818] To illustrate this, Pauli deliberately misquoted Goethe: 'That which to the field is in resistance set – The body of this clumsy world – has yet' (*was sich dem Feld entgegenstellt, der Körper, diese plumpe Welt)*.[819]

It is the world itself, reality and life that break down the beautiful theoretical construct of the scientist. Einstein's static worldview is 'absolute' and in itself passive and therefore becomes metaphysical. But reality is what *acts*, what has an *effect* – a quantum of action! Pauli accepts Jung's definition of reality: *'Only that which acts upon me do I recognize as real and actual. But that which has no effect on me might as well not exist.'*[820] The background to Einstein's realistic metaphysics lay in his fear of not being able to distinguish between 'the real' and 'the imagined'. Both Pauli and Bohr had a broader view concerning the concept 'objective description of nature'. Physics should be defined as 'the *description* or the conceptual interpretation of the *reproducible*

[816] Pauli to Fierz, 19 Jan. 1953 [1507, attachment], *PLC IV/2*, Laurikainen, 91.

[817] The body is by definition a defined unit, whereas the field represents an interrelation, a connecting principle.

[818] Pauli to Fierz, 11 Apr. 1953, [1552], *PLC IV/2*.

[819] In the original it says: 'That which to nought is in resistance set – The something of this clumsy world – has yet' ('Was sich dem Nichts entgegenstellt, Das Etwas diese plumpe Welt'), Goethe's Faust, Part I, student's room scene.

[820] Pauli to Jung, 27 Feb. 1953 [58], note 22, *PJL*. Cf Jung, 'Answer to Job', *C.W.*11, §757.

(including that in nature which reproduces itself).'[821] Pauli found this definition more apt than the contrasting of the real and the imagined – especially as he did not wish to deny the 'imagined' a reality of its own.

In modern physics reproducibility is guaranteed by probability calculation. The corresponding tool in depth psychology is the concept of the archetype, which is defined *as a self-reproducing form*.[822] The archetype theory can find empirical support if it can be shown that certain typical motives, conceptions, patterns of action and customs arise spontaneously in every epoch and culture. An additional condition is of course that no satisfactory explanation can be given from a pure diffusion perspective.[823] If one can in this way show that psychic products display typical, recurring formations, that is to say that psychic nature *reproduces* certain patterns – depth psychology satisfies the preconditions for a scientific theory.

[821] Pauli to Heisenberg, 5 Jul. 1954, [1842], *PLC IV/2*.

[822] Pauli, 'Ideas of the Unconscious', *WPP*, 164.

[823] One of the few clinical examples to which Jung returns and which may have given him the germ of the theory of the collective unconscious and the archetypes is the 'solar phallus man'. This was a schizophrenic man who in one of his visions in 1906 saw that the sun had a phallus, whose movements caused the wind. Jung is reported to have found this vision later in a translation of an old Greek papyrus which it was impossible for the patient to have known about. In *The Jung Cult*, Richard Noll has shown how Jung falsified facts surrounding this case. We know that Jung's archetype theory goes back to early influences (before 1906), such as his reading of gnostic texts. Jung later stated that he did not see the solar phallus man as evidence of the archetype theory, only as an example of an approach which might be possible to use in the search for evidence. In material written after 1936, Jung no longer referred to this case. Noll, 181–84; Jung, 'Symbols of Transformation', *C.W.5*, §150–54; idem, 'The Concept of the Collective Unconscious' (1936), *C.W.9I*, §110.

The Reality of the Symbol

'The layman usually means, when he says ›reality‹, that he is speaking of something self-evidently known; whereas to me it seems the most important and exceedingly difficult task of our time is to work on the construction of a new idea of reality'.[824] Pauli was convinced that the philosophical position that could reconcile the state of opposition between classical philosophical doctrines like positivism and realism was the recognition that *reality is symbolic*. In the past philosophical theories which focus on 'the observable' (such as positivism, phenomenalism, sensualism and empiricism) have always been set against those which focus on the underlying structure (like metaphysical realism, idealism, rationalism, determinism). Although all statements on the true nature of reality belong to the area of metaphysics, one can never create a system of ideas where this question is eliminated. If so it is more honest to form an explicit opinion on how we look at reality than to pretend that one has succeeded in avoiding the question. Pauli regarded it as the task of his time to grapple with this subject. To see reality as symbolic takes us a step further towards establishing an ontology and epistemology which deals with the opposites in a symmetrical manner. The concept of the symbol takes over the role which the 'thing in itself' played in Kant's philosophy and is an attempt to approach a unified psychophysical worldview.

Jung's concept of the symbol combines, as we have seen, the manifest, measurable and rationally articulated with the multi-dimensional, ambiguous and inexhaustible. Let us recapitulate: Jung sees a living symbol as the best possible expression of something divined but not yet fully known – something which cannot be represented in a more characteristic way than in the form taken by the symbol. If one says that the cross is a symbol of divine love, then according to Jung one gives a semiotic *explanation* of the cross, which is something quite different from seeing it as a symbol. If on the other hand one believes that the cross is beyond all conceivable explanation, but that it is still the most apt expression of an as yet unknown and incomprehensible fact, then one has a symbolic attitude to the cross. The symbol always consists of a known or rational part and an unknown or irrational part, which

[824] Pauli to Fierz, 12 Aug. 1948, [971], *PLC III*, 559.

is not accessible to reason. The known part of the symbol is represented by its current form while the unknown part opens up to the non-visual aspect of the archetype. The state of tension between known and unknown gives the symbol a numinous character, which lends it a power of attraction. Our fascination with and manipulation of the symbol gradually leads to a discovery of the true characteristics of the object and the symbol increasingly produces real knowledge. In this way the unknown is made conscious and thus the symbol loses its power of attraction and 'dies'. Jung's concept of the symbol actually describes a process which includes *participation mystique*,

projection, awakening or revision of the contents of the projection, separation of the projection and the object, a new perspective on the symbol, alternatively increased knowledge of the object, and exhaustion of the energy of the symbol by hundred-per-cent transformation into knowledge, in other words the death of the symbol.[825] Using this concept one might be able to describe the process of cognition from a new perspective. With it one can shed light on the underlying process of scientific discovery – a process which resembles the therapeutic process – if, like Jung, one sees the therapeutic process as a *synthetic* or *constructive* one.

A scientist who is wrestling with a scientific riddle uses all his conscious capacity, in other words all the knowledge of the subject that he possesses, and then tries as hard as he can to see into the unknown. When the solution has once been formulated it often arrives in a ready-made and finished form. The solution can seldom be reduced to the known elements with which one started, but would nevertheless be impossible if one had not started and worked with just these elements. Both the problem worked on and the solution can have an archetypical quality or symbolic character. That is why this sort of creative work so often is accompanied by strong emotions that lends the results the stamp of absolute truth. When however the problem has been entirely worked through, the force ebbs out of the solution and it is either refuted or becomes an integrated part of a working theory. Finally it may 'die', like an old religious symbol or an old theory with which nobody is any longer concerned.

This whole process may be compared with Jung's description of the constructive or synthetic method in therapy. A common reason for people to seek therapeutic help is that in one way or another they are not getting any-

[825] An excellent survey of Jung's symbol concept from a comparative perspective may be found in Morris H. Philipson, *An Outline of Jungian Aesthetics* (Boston, 1963). It includes a comparison of Jung's view of the symbol with that of Ernst Cassirer. See also Petteri Pietikäinen. *C.G. Jung and the Psychology of Symbolic Forms* (Saarijärvi, 1999).

Comparison of scientific discovery and the therapeutic process[826]

Scientific discovery	*Therapeutic process*
1) Problem to be solved.	1) Neurosis. (Locking of mental energy.)
2) Concentration of all the investigator's conscious capacity. (Accumulation and updating of all knowledge on the subject.)	2) Amplification with personal and collective material. (Work on all information concerning the patient's condition, personal history, current life situation, dreams, fantasies and its mythological parallels.)
3) Intensive work. (Work on the problem by at the same time both clarifying one's mind about the known material and also looking into the unknown.)	3) *Religio*. (Accurate observation of the information from the unconscious, giving the unconscious a possibility of expression.)
4) Solution. (The solution often comes in integral 'symbolic' form with a strong emotional character of 'absolute truth'.)	4) Transcendent function. (Reconciliation with the unconscious. The emergence of a new living symbol which bridges the division and interweaves conscious and unconscious in dynamic, vigorous combination.)
5) Processing into a scientific theory. (Testing, verification/refutation.)	5) Integration and making conscious of the symbol.
6) The scientific theory becomes inadequate.	6) The symbol dies.

where in their lives. In energetic terms one might say that they are 'stuck' in a conflict between the intentions of the conscious and the demands of the unconscious. In such a locked situation the psychic energy regresses and animates the unconscious.[827] The first stage in the analysis of the patient is to ascertain the state in which he or she finds himself/herself, and to work with the information which is available in the form of, for example, dreams or fantasy images. These have to be amplified, in other words the patient must become as conscious as possible of his condition and carefully observe his associations with the situation. This process is intended to clarify the situation so as to make it an articulated problem.[828] By thus letting the conscious and the unconscious collaborate, by giving the unconscious an opportunity to express itself in some form or another, the first step is taken towards a recon-

[826] This diagram is the construction of the author.
[827] Jung, 'Psychological Types', *C.W.*6, §824.
[828] Idem, 'The Transcendent Function', *C.W.*8, §167.

ciliation of the conscious and the unconscious. This occurs in the formation of the *transcendent function*, which is a function that transcends the previous division. The 'transcendent function' usually has the form of a living symbol, which is created from the earlier conflict, but which is more than the sum of the constituents of the conflict, because it is a third thing and unique.[829] It consists of a new attitude which interlaces conscious and unconscious in a dynamic and vital combination.[830]

It is first and foremost in the concept of *symbolization* that Jung's therapeutic method shades over into a general epistemological model. In his text on psychic energy he describes how all culture and knowledge has arisen from the symbolizing process. According to Jung, symbols have always arisen spontaneously, just like dreams. With their power of attraction they function in a way similar to the libido. This means that a given quantity of psychic energy which is tied up in a certain form can be transformed and given an analogous expression without losing its intensity. This enables it to attract interest and to break man's subjugation to primary drives. Involvement with symbols and symbolic material, such as mythological and magical customs, forms the source from which springs our science.[831] The attraction of the symbol is entirely analogous with the fascination which scientific puzzles hold for the modern scientist. According to Pauli, the symbol occupies a central position in our understanding of both matter and the human soul.

> For every truth also contains in part something unknown, only divined and therefore also a hidden opposite of the sense known to him. (I now believe this is also what the psychologists call 'symbol' and it does not seem to me to be so very different from what the mathematicians call 'symbol'. [–––].)[832]
>
> The symbol is always an abstract sign, whether it is quantitative or qualitative, whether it is mathematically imaginary or emotionally charged (feeling-toned). Only a part of the symbol is expressible through conscious ideas, another part acts on the 'unconscious' or the 'preconscious' condition of man. The same applies to mathematical signs, for only those for whom these signs (in the explained sense) possess symbolic power have a gift for mathematics. The symbol is always a tertium [third] which unites opposites, which logic alone cannot provide.[833]

The symbol possesses both materiality and abstraction. It includes a dynamism and presupposes an interaction between subject and object and includes both observation and comprehension. The symbol is *both* a product of human effort *and* a sign of an objective order in the cosmos. It contains

[829] Ibid., §189.
[830] Idem, 'Psychological Types', *C.W.*6, §828.
[831] Idem, 'On Psychic Energy', *C.W.*8, §88 ff.
[832] Pauli to Goldschmidt, 19 Feb. 1949, Goldschmidt, 24.
[833] Ibid., 27.

information both about man and about the world. Robert Segal has summarized Pauli's view of the reality of the symbol in a simile: a symbol is like a shop window – sometimes it reflects our own image and sometimes it allows us to see what is behind the glass. What we see depends on the angle.[834] The symbol is related to a deeper-lying structure beyond the phenomena, as it constitutes a *possible concrete form of manifestation* of the archetype or the non-visual structural factor. The wave function of quantum physics is in this sense a real symbol because it expresses the relationship between abstract possibility and observable event. The symbol always forms an abstraction of something which goes beyond itself, whether it is of a mathematical or an emotional character. In physics the atom has the quality of a symbol, how else could it be 'both wave and particle'? The concept of the symbol particularly appeals to Pauli because it possesses everything that Pauli values: symmetrical relationship with the opposites and a transcending of psychophysical boundaries. [835]

> A symbol is on the one hand a product of human effort, on the other a sign of objective order in cosmos, of which man is only a part. It has something of the old concept of God and also something of the old concept of the material object. [...] The symbol is symmetrical in relation to 'this life' and 'the hereafter', i. e. two-sided in the sense of the understanding of the cognitive process which you have proposed; it has a relationship with the 'observed' and with the 'concepts', it may be mathematical or also more primitively figurative.[836]

With the aid of the symbol it is also possible to develop a new angle of approach to the relationship between science and religion. With the symbolic approach the interplay between cosmos and man comes into focus. One example of this is provided by the symbolic concept of *incarnation*, which in itself represents a description of how the symbol functions: it is an interaction between 'the possible' and 'the actual' which results in 'becoming', incarnation or the unique creation. Science as a discipline must in turn realize that science created by man always includes statements about man. The object of science will therefore always be man himself and his totality; in him is the ethical conflict between good and evil, in him is spirit and matter.[837]

[834] Segal, 253.
[835] Pauli to Fierz, 12 Aug. 1948, [971], *PLC III*, 559–60.
[836] Pauli to Fierz, 12 Aug. 1948, [971], *PLC III*, 559–60.
[837] Pauli to Jung, 27 Feb. 1953 [58], *PJL*, 95.

Synchronicity: Jung's Spiritual Testament

The miracle – the unique moment of creation – which had been banished from the worldview, had unexpectedly returned in a new guise. Now in physics it is the observation itself which is an unique act of creation. Something had quickly to be done to save the most important principle of physics: *Reproducibility*. Without it there is no possibility of formulating general laws, which is after all the goal of physics and of science.

In order to be able to maintain reproducibility in atomic physics one was obliged to introduce the statistical calculation of probabilities as an a priori, fundamental part of physical theory. This was the price one had to pay to keep the 'unique' in check.[838] Bohr had already during the period 1913–18 introduced such a theory called the *correspondence principle*, which was a predecessor of the later complementarity principle. By the introduction of stationary states into the atomic model Bohr had succeeded in explaining the irregular spectral lines of the hydrogen atom. The theory of the transitions between the stationary states gave a new explanatory model for the frequency of light which conflicted with classical electrodynamics. In his attempt to find a model which could combine the classical theory with the new discoveries Bohr demonstrated that in the area of the high quanta – in other words at a great distance from the atomic nucleus – the predictions of classical theory asymptotically approached those of the quantum theory. In this area the well-known results of classical electrodynamics may be placed on an equal footing with the descriptions provided by quantum theory. This asymptotic identity is then assumed also roughly to hold good in the regions near the atomic nucleus.

Bohr sought in this principle a compromise between classical physics and quantum mechanics. At that time he still hoped for a resolution of the contradictions by concentrating on the area in physics where the two overlap, in other words where one obtains a meeting or a correspondence of the predictions of the two theories. The correspondence principle therefore formed an intermediate link between quantum physics, with its discontinuities, and classical determinism.[839] The same theoretical thinking recurs in the abstract mathematical wave function ψ. Just as the correspondence principle recon-

[838] Pauli to Jung, 24 Nov. 1950 [45], *PJL*.
[839] Wolfgang Pauli, 'Niels Bohr on His 60th Birthday' (1945), *WPP*, 52 f.

ciles classical electrodynamics and quantum theory, the wave function unites our graphic conceptions of continuity and discontinuity, in other words of the wave and particle picture. Therefore Pauli describes the wave function as a truly reconciling symbol.[840] To save reproducibility a *new kind of natural law* is introduced which is based on correspondence, similarity, equivalence or matching between two non-causally connected areas. This new type of natural law is seen as a rational *generalization* of the determinist law of classical physics. Pauli at once noted the similarity between this 'new' natural law and the medieval doctrine of *correspondentia*, which is based on the assumption of a correspondence between microcosmos and macrocosmos.[841] *The even older is always the new*, Pauli noted.

As a result of this development in physics Pauli was very interested in Jung's concept of synchronicity. The principle of synchronicity is an attempt to pinpoint, alongside the law of causality, another factor ordering the world of our experience – a factor which builds on *relatively simultaneously occurring constellations of a certain quality or significance*. Jung found the inspiration for this principle in his contact with Chinese thought passed on to him by the Sinologist Richard Wilhelm. In a letter to Carl Seelig, Jung says that the very first seeds of the principle came from Einstein. In 1911 Einstein had been at a dinner given by Jung and told him about his theory of relativity.[842]

> It was Einstein who first started me off thinking about a possible relativity of time as well as space, and their psychic conditionality. More than thirty years later this stimulus led to my relation with the physicist Professor W. Pauli and to my thesis of psychic synchronicity.[843]

It was a long time before Jung dared to publish anything extensive on synchronicity. The 'strange psychic parallelisms' of which Jung speaks are part of

[840] Idem, 'The Philosophical Significance of the Idea of Complementarity', *WPP*, 40 footnote 1.

[841] Pauli to von Franz, 12 Nov. 1949 - Hs 176:6, *WHS*, unpublished, (will appear in *PLC suppl.*); Pauli to Fierz, 26 Nov. 1949 [1058], *PLC III*, 709; Pauli to Jung, 4 Jun. 1950 [38], *PJL*, 44.

[842] Cf Ira Progoff, *Jung, Synchronicity and Human Destiny* (New York, 1973), 151 f. Progoff claims that Jung told him that Einstein had often visited him and that they had had many long discussions. He also implies that these discussions were of importance to Einstein, because Einstein's papers have shown that dreams and mental images also played a large role in Einstein's thinking. This statement should be taken with pinch of salt. We certainly know that Einstein visited Jung with other guests on two or three occasions. In a letter to Freud in 1911 Jung mentions that he has had a dinner at which he spent the whole evening talking to a physicist about the 'electrical theory of light'. (Jung to Freud, 18 Jan. 1911 (230 J), *The Freud-Jung Letters*, 384.) If Jung had made any great impression on Einstein, or if the discussions between them were of any significance, this would surely have come out in the correspondence with Pauli. Not once does Jung mention his 'many long' discussions with Einstein to Pauli. Nor does Pauli seem to have discussed Jung with Einstein, which he would quite certainly have done had Einstein showed the slightest interest in dreams and suchlike. See also Deirdre Bair, *Jung: A Biography* (Boston, 2003), 252.

[843] Jung to Carl Seelig, 25 Feb. 1953, *C.G. Jung Letters*, vol. 2, 109.

the everyday experience of most people, but because of their strangeness they are at best brushed aside as curiosities. As such occurrences go beyond our cherished view of reality, most people choose to ignore them or to dismiss them by labelling them 'chance'. An example of such an experience occurs when we have dreamed or suddenly thought about a person with whom we have not had contact for a long time and, shortly afterwards, we receive a telephone call or a letter from that person. Jung noted that the word 'chance' is usually used in everyday contexts to 'fill in' gaps in our knowledge. If we note a strange occurrence which falls outside the expected, we tend to use the term 'chance' to describe it and at the same time to dismiss it. As a psychotherapist Jung had observed that so-called 'chance' often plays a decisive role in a person's life. A turning point in the healing process may sometimes be accompanied by external and internal events that 'arrange' themselves in a 'meaningful manner'. The effect is a strong emotional reaction, an 'a-ha' experience.

One example of this which Jung quotes in his essay on synchronicity concerns a female patient who is no longer making progress in her analysis. The woman has difficulty in getting beyond her narrow rational view of life. Then one night she has a very vivid dream that someone is giving her a costly ornament in the form of a golden scarab. At the very moment when she is telling Jung about this dream something taps on the window and when Jung opens it, into the dark room flies a rose chafer (*cetonia aurata*), which, Jung says, is relatively rare in the area. Jung catches it and hands it over to her with the words 'here is your scarabee'. She is very shaken by this incident and it jerks her out of the paralysed situation in which she finds herself. The analytical process then proceeds rewardingly.[844] Another type of circumstance which Jung was inclined to include in the concept of synchronicity was the occurrence of events which accumulate in such a way as to point towards a particular content. This phenomenon is often experienced by people who are deeply involved in a particular set of problems or a particular research project. Jung gives such an example from his own experience: on 1 April 1949 he was given fish for lunch and someone mentioned that it is customary on 1 April to make an April fool of someone (symbolized in some countries by a fish). Later that day Jung noted a Latin inscription *Est homo totus medius piscis ab imo*. In the afternoon he met a former patient whom he had not seen for several months. She showed him very striking paintings of fish that she had done. In the evening he was shown an

[844]C.G. Jung, 'On Synchronicity' (1951), *C.W.*8, §982.

embroidery of sea monsters. Next morning another former patient came and told him that she had dreamed that she was standing on a beach and had seen a big fish swim towards her and land at her feet. Jung links these occurrences by saying that at the time he was deeply preoccupied with a study of the symbolism of fish in history. He concludes his tale with a footnote telling us that while he was writing this material he was sitting by the lake. Just after finishing a sentence about fish being symbols of unconscious content and it hardly being possible to see these occurrences as chance groupings, he walked over to the sea wall and there lay a dead fish, uninjured, about a foot long.[845]

Although it occurs relatively frequently, this type of experience belongs to a taboo category and is usually dismissed with 'you see what you want to see'. The subjective, inner life cannot possibly be co-ordinated with the objective, outer life in this manner. It was therefore only after receiving Pauli's encouragement that Jung dared to publish anything more detailed on the subject. One of the reasons why Pauli took these phenomena seriously was of course his personal experience of such random coincidences. These incidents, which acquired the name *Pauli Effect*, made such an impact that even as great a sceptic as Oskar Klein said that these 'true – but nevertheless obviously misleading' phenomena were as well-attested a 'supernatural' effect as any.[846]

Jung grew up in a family where the women on the maternal side were known for their clairvoyant powers and there was a lively interest in spiritualism and parapsychology among his kin. Jung's doctoral dissertation was based the trances and alternate 'spirit' personalities of his mediumistic fifteen-year-old cousin Hélèn Preiswerk. Jung himself told of many strange coincidences in his life of 'paranormal' quality, like the cracking of a round walnut table in half and the splitting of a kitchen knife into four parts, haunted houses, encounters with spirits and such.[847] One of the well-documented incidents concerns Freud's cracking bookcase, which is discussed in the Freud-Jung correspondence in 1909. Freud had just anointed Jung his 'crown prince' and successor when Jung, visiting Freud in Vienna, raised the question of spiritualistic phenomena. As Freud dismissed the question as nonsensical Jung felt a curious sensation in his diaphragm 'as it were made of iron and were becoming a red-hot, glowing vault' (to be compared with Pauli's experience of the 'Pauli Effect' as an unpleasant tension).[848] At that moment there was a loud report in the bookcase. Both were startled and Jung said to Freud that

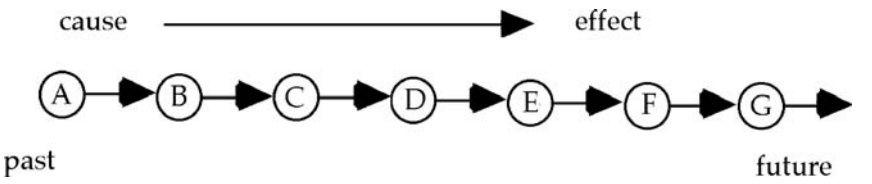
[845] Idem, 'Synchronicity: An Acausal Connecting Principle', *C.W.*8, §826.
[846] Klein, 'Vetenskap och fördomar', 493.
[847] C.G. Jung, *Memories, Dreams, Reflections*, ed. Aniela Jaffé (Glasgow, 1977), 125 ff.
[848] Markus Fierz, 'Naturerklärung und Psyche: Ein Kommentar zu dem Buch von C.G. Jung und W. Pauli' (1979), *Naturwissenschaft und Geschichte* (Basle, 1988), 190.

this was an example of so-called catalytic exteriorisation phenomenon. When Freud once again dismissed the whole idea as absurd, Jung exclaimed: 'No it is not, you are mistaken Herr Professor', and predicted that it would happen again. And so it did.[849] The deeper significance of this event is described in Freud's letter to Jung: 'It is strange that on the very same evening when I formally adopted you as eldest son and anointed you [...] as my successor and crown prince, you should have divested me of my paternal dignity...'[850] This interpretation was a prophetic one. It is in fact a good example of synchronicity. Here we are dealing not only with a strange coincidence but also with the personal profiles of these two men (father authority/rebellious son), the central difference in worldview (attitude towards the spiritual) and the future destiny of their relationship.

The first time the term synchronicity appears in Jung's literary remains is in a seminar note from 1928 (these notes have now been published). In it the differences between the Western and the oriental perspective are discussed. Thinking in *simultaneities* is said to be typically Chinese, whereas it is typically Western to think in terms of 'before and after', i.e. of cause and effect.[851] In December 1929 Jung says: 'I have invented the word *synchronicity* as a term to cover these phenomena, that is, things happening at the same moment as an expression of the same time content.'[852] In 1930 the concept occurs in print for the first time in a paper in memory of Richard Wilhelm. Here Jung states that he considers that the 3000-year-old Chinese book of prophecy and wisdom *I Ching* has to be regarded as the highest product of Chinese culture. It was, so to speak, the equivalent of what we call science. But Chinese science is based on principles entirely different from our causalist ones in the West.

> My researches into the psychology of unconscious processes long ago compelled me to look round for another principle of explanation, since the causality principle seemed to me insufficient to explain certain remarkable manifestations of the unconscious. I found that there are psychic parallelisms which simply cannot be related to each other causally, but must be connected by another kind of principle altogether. This connection seemed to lie essentially in the relative simultaneity of the events, hence the term 'synchronistic'. It seems as though time, far from being an abstraction, is a concrete continuum which possesses qualities or basic conditions capable of manifesting themselves simultaneously in different places by means of an acausal parallelism, such as we find, for instance, in the simultaneous occurrence of identical thoughts, symbols, or psychic states.[853]

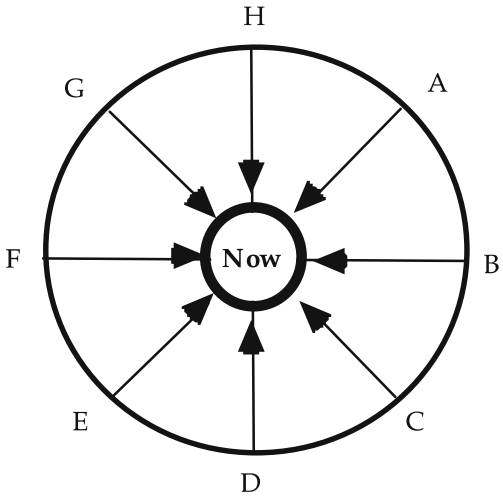
[849] C.G. Jung, *Memories, Dreams, Reflections*, ed. Aniela Jaffé (Glasgow, 1977), 155.
[850] Freud to Jung, 16 April 1909 [139F], *The Freud-Jung Letters*, 218.
[851] *Dream Analysis. Notes of the Seminar Given in 1928–1930 by C.G. Jung*, ed. William McGuire (London, 1984), 44–45.
[852] Ibid., 417.
[853] C.G. Jung, 'Richard Wilhelm: in Memoriam' (1930), *C.W.*15, §81.



Western explanation of correlation

One could compare the Western causal explanation and its concept of time with the Chinese by comparing two mental images.[854]

To the Westerner it is natural to think in the form of a time lapse, where cause precedes effect. An explanation has been obtained if we can show how a current state of affairs can be derived from a preceding cause. A question such as 'what came first, the chicken or the egg', becomes relevant to us. From the point of view of Chinese thought, as encountered in classical Chinese philosophy, our reasoning is certainly comprehensible and logical, but it is without explanatory value. There is no explanatory value in being able to trace a situation back to an earlier one. The relevant question is, rather: 'why do these things happen at the same time?'



Field of time
(time-bound ensemble of events)

Chinese explanation of correlation

[854]This comparison is based on Marie-Louise von Franz, *On Divination and Synchronicity* (Toronto, 1980), 8.

[855]Marie-Louise von Franz, *On Divination and Synchronicity* (Toronto, 1980), 8.

Instead of an arrow, a field is a more suitable analogy here. The centre of the field is a moment in time around which certain events are grouped. The events form a complex pattern around the point in time, as if time behaved as a magnet which attracted certain events. But the events are not causally associated with each other and time does not cause their grouping; rather the events express the *quality* of the moment in time. Time is not merely an abstract parameter, a before and after, which links cause and effect. Time is above all a *quality*, expressing a pattern which has a significance or meaning. All the events which are grouped in the same moment of time are interconnected and it makes no difference whether these events are of an internal or an external nature, in other words whether the event is psychic or physical. The observation of the branch of the plum tree at a certain moment, the arrival of two birds, the surrounding landscape, the weather and the feelings and thoughts of the observer at the time are all interrelated.[856] Jung later seems to have dropped the assumption of time being the active agent in synchronicity. Time as concrete continuum with qualities is a notion that comes pretty close to Henri Bergson's concept *la durée*.[857] Instead Jung emphasizes that the concept of time depends on psychic conditions and that 'in themselves, space and time consist of nothing', they are creations of the conscious mind.[858] Synchronicity is a falling together in time, a meaningful coincidence based on the same living reality expressing itself in a psychic as well as physical state.

One should make a careful distinction between this perspective and 'magical thinking'. Magical thinking is as causal as our modern scientific thinking. It differs from so-called scientific thinking only in that it makes no distinction between psychic and physical, it being assumed that a psychic cause, such as an evil thought, can result in a physical effect – such as bad weather or sickness. Scientific thinking makes a strict distinction between subject and object and between psychic and physical. The physical can only have physical causes and the psychic, if such a thing is even allowed to exist in its own right, only psychic causes. One of the consequences of our causal thinking is that we do not know how a connection between the mental and the physical could be postulated without the one being reduced to the other. The alternative is often a relapse into magical thinking. This constitutes a major problem in psychiatry and medicine as far as the handling of psychosomatic disorders is concerned.

[856] Wen Kuan Chu & Wallace Andrew Sherrill, *An Anthology of I Ching* (London, 1978), 54–55.

[857] Henri Bergson defines this concept in opposition to Einstein's theory of relativity. Henri Bergson, *Durée et simultanéité. A propos de la théorie d'Einstein* (Paris, 1922).

[858] Jung, 'Synchronicity: An Acausal Connecting Principle', *C.W.*8, §840 f.

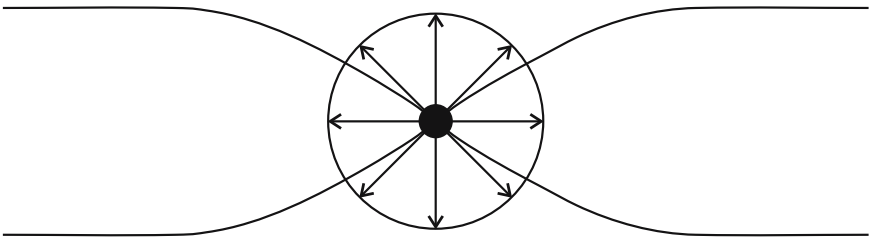
In his essay *The Spirit of Psychology* (*Der Geist der Psychologie*) Jung had discussed the numinosity of the archetypes and their importance to religious phenomenology and the psychology of religion. The effect of an archetypal experience – an encounter with the 'holy' – can be both healing and destructive to a person. Such a powerful experience leaves nobody who has been through it unchanged. Intense religious experiences are sometimes accompanied by so-called paranormal phenomena. These phenomena may in part be of a psychosomatic character, such as the appearance of stigmata on the person's body, but bleeding statues of Christ and weeping images of the Madonna may also be included in the phenomenology (if we assume that not all of these incidents are fabricated).[859] The characteristic of synchronistic phenomena is a coincidence of subjective and objective facts – in other words that an internal, subjective state coincides with an external event which is directly related to the internal state. The theoretical possibility of corroboration of the coincidence by an independent observer is also important, even if, in practice, such an observer is seldom at hand. Jung also discusses synchronicity in connection with telepathy and other parapsychological phenomena which seem to imply a certain relativization of time and space in the psychic sphere. Earlier in the essay he had stated that the archetypes constitute non-visual operators whose innermost nature we do not know. Our conscious sphere is filled with current images and conceptions which are time-and-space-determined variations of the underlying, non-visual operators. Therefore it is not too far-fetched to assume that the archetypes *in themselves* are not subordinated to time and space, and that perhaps they could also relativize the space-time continuum when they break into the sphere of consciousness from this time-and-space-relative stratum.

Jung points out a genuine complementarity relationship here: when an unconscious content passes over into consciousness its synchronistic manifestation – i.e. as paranormal phenomena – ceases. Conversely it is possible to produce synchronistic phenomena by putting a person in an altered state of consciousness, for example a trance. The same situation may be observed in the treatment of psychosomatic conditions; the clinical symptoms disappear when corresponding unconscious material is made conscious, just as psychosomatic symptoms may be produced by hypnosis, in other words by a restriction of consciousness.[860] These observations made Jung inclined to link the appearance of synchronistic phenomena with psychological borderline conditions – such as periods of disorientation and lability – which

[859] Jung, 'On the Nature of the Psyche', *C.W.*8, §405, footnote 118.
[860] Ibid., §440.

particularly appear when a person undergoes dramatic changes in life. During such periods the individual also shows greater affectivity and sensitivity, factors which are closely related to synchronicity. We also recognize this relation between borderline conditions and synchronicity in cultural practices, especially among aboriginal people with surviving shamanistic cultures. By different ecstatic techniques the shaman puts himself or herself in a borderline state of altered consciousness in order to be able to transcend the boundaries of our everyday world and to restore the cosmic order, heal the sick or predict the future. The principle of synchronicity thus hypostatizes an ordering principle which is *psychoid* – or as Pauli preferred to call it, *psychophysically neutral* – in other words a principle which structures both psyche, body and matter and which in addition relativizes time and space.

The first reference to the concept of synchronicity in Pauli's correspondence is in February 1948. It occurs in a letter to Pascual Jordan, in which Pauli advises him of Jung's essay *The Spirit of Psychology*. Jordan had just sent Pauli his book *Verdrängung und Komplementarität (Repression and Complementarity)*, in which he, too, had shown his interest in parapsychological phenomena. Pauli's tone in the letter to Jordan is rather critical: He does not consider Jung's essay a particularly good one and he personally does not believe that it is possible to substantiate parapsychological phenomena.[861] At the same time we know that during this period Pauli was actually developing a growing interest in such matters. Apparently we have here an example of Pauli showing one face to his colleagues and another to his Jungian friends. On Saturday 6 November 1948 Pauli and Jung discussed synchronicity for the first time. The following day Pauli wrote to Jung that in order better to understand what Jung means by synchronicity he has had to resort to an 'auxiliary conception'. Just like Bohr, he used the multi-leafed surface of the mathematician Bernhard Riemann as an analogy (see next figure).



Riemann surface

[861] Pauli to Jordan, 21 Feb. 1948 [939], *PLC III*, 510.

The image is intended to represent a cross-section of two leaves, lying horizontally (seen from the drawing surface), linked by an intersection at the midpoint. The number of leaves may be infinite, but here there are only two for the sake of simplicity. By circling round the centre it is possible to move from the upper to the lower leaf and vice versa. Pauli now imagined the centre as the self-regulating centre of the psyche, *the Self*, or the 'radioactive nucleus', as Pauli preferred to call it. From this centre radiate the synchronistic effects. The lower leaf then represents the subjective factor, such as a dream, whereas the upper leaf represents an external, objective event which is associated with the dream. The centre, between the two leaves or layers, represents an order which is outside space and partially outside time. It is also beyond the distinction of psyche and matter. This 'organizer' of psyche and matter would then be equivalent to what Jung calls archetype. With this definition the Self becomes not only a self-regulating principle encompassing the totality of all *psychic* phenomena but also an superordinate organizing principle overarching psyche and world.[862]

The discussions, together with Pauli's consistent support, eventually led Jung to compile a text on synchronicity which he sent to Pauli on 22 June 1949. At the same time he thanked Pauli for all his encouragement.[863] After many further discussions and debates in letters and verbally with Markus Fierz, C.A. Meier, Max Knoll and Marie-Louise von Franz the work was published in 1952 together with Pauli's article on Kepler.[864] It was Pauli who proposed the title *Naturerklärung und Psyche* for the book. He also proposed the English title *The Interpretation of Nature and Psyche* for the translation of the work which appeared in 1955.[865]

Here I intend to take up only a few of the main points which appear particularly urgent to Pauli in connection with synchronicity.

- The significance and quality of a certain moment in time which answers the question: 'Why does this happen at the same time?' Keyword: '*coincidence*'.
- The significance of the *affective* factor: heightened awareness or sensitivity in connection with exceptional psychic states (e.g. periods of disorienta-

[862] Pauli to Jung, 7 Nov. 1948 [35P], *PJL*. For a discussion of the parallels betweeen Jung's view of the Self and today's Dynamic system theory see George B. Hogenson (2003), 'What are Symbols Symbols of?: Situated Action, Mythological Bootstrapping and the Emergence of the Self', *The Journal of Analytical Psychology*, Volume 49 (2004), 67–81.

[863] Jung to Pauli, 22 Jun. 1949 [36], *PJL*. See also Jung to Pauli, 13 Jan. 1951 [49].

[864] Max Knoll, professor of electronics, Princeton University. He gave the lecture 'Wandlungen der Wissenschaft in unserer Zeit' at the Eranos Conference of 1951 (*Eranos-Jahrbuch* 1951 (Zürich, 1952).)

[865] Pauli to von Franz, 25 Jul. 1951 [1267], *PLC IV, PLC IV/2,* 120.

tion), the sense of *attentiveness* in the form of expectation, involvement and meaningful experience. Keyword: *numinosity*.

- ➢ Similarity, analogy, equivalence, convergence, contingence, sympathy, harmony. Keyword: *correspondence*.
- ➢ Causeless order, archetype, constellation, 'automorphism'. Keyword: *self-reproducing form*.
- ➢ Parallelism between two psychic systems (e.g. telepathy), parallelism between a psychic system and the physiological system (psychosomatization), parallelism between a psychic system and a physical system (e.g. precognition, psychokinesia), and parallelism between two or more physical systems (general acausality). Keyword: psychophysical *transcendence*.
- ➢ The unique, the new, the spontaneous. Keyword: *creation*.

Pauli's main criticism of the concept of synchronicity is one that we recognize: The concept is too broad and fuzzy. With his new concept Jung attempts to summarize a number of occurrences in one intuitive generic term. Pauli wished instead to specify the concept by looking more closely at the components that Jung had brought together under one single heading. With his critical disposition he found himself constantly irritated by Jung's careless concept formation and drifting perspectives, while at the same time he found the discussions with him stimulating and fertile. He expresses this in a letter to Fierz as follows:

> May this now be a good omen as regards my relationship with physics and psychology, which undoubtedly is among the peculiarities of my intellectual existence. What is decisive to me is that I *dream* about physics as Herr Jung (and other non-physicists) *think* about physics. The danger of this situation lies in Herr Jung publishing nonsense about physics and could moreover quote me in the process. The thing is to prevent this and to turn the matter to advantage. I simply *cannot* evade it! But every time I have talked to Herr Jung (about the 'synchronistic' phenomenon and such), a certain spiritual fertilization takes place (in dreams it takes the following form: I dream either that a stranger is bringing me a big book – sometimes I also manage to read it – or a woman is having many children – I interpret these as ideas or 'intuitions').[866]

To tackle the problem of Jung's lack in knowledge of physics and to help him clarify his 'dreamlike' concepts Pauli proposes to interpret Jung's analogies to physical concepts as dream symbols. Pauli here takes on the role of the psychologist and helps Jung to understand how he 'misuses' physical concepts by only seeing the analogies and not the differences between concepts. Jung seems to have appreciated this; he calls Pauli's approach to

[866] Pauli to Fierz, 26 Nov. 1949 [1058], *PLC III*, 708.

him 'psychotherapeutic'.[867] Pauli had from the start a very well-defined opinion of synchronicity: it represents a coinciding of an internal condition – for example a particular state of consciousness – and an external process which is related to the internal condition. The relationship between the internal and the external appears meaningful, in other words a kind of 'sense in chance'. Pauli therefore felt that the emphasis ought to be on the experience of meaning and significance, not on the relative simultaneity as is implied by the concept *synchron*icity. It would be more appropriate to speak of a meaningful connection or *correspondence of meaning*. The Σ phenomena (Σ is used as abbreviation for synchronicity) often arises in conjunction with a transition from an unstable state of consciousness into a new stable state, when consciousness has expanded and an equilibrium with the unconscious has been established. During the unstable state, i.e. during the transition, it seems as if the new insight has to be reinforced by the appearance of physical marginal phenomena. When the new conscious position is attained and has stabilized, the marginal phenomena disappear. Pauli took this from his personal experience. He emphasized that with him the synchronistic phenomena always occurred in connection with certain states of consciousness and in relation to certain stages in life, especially when the 'opposites keep in balance as much as possible'.[868] On one occasion he even states that the synchronistic phenomena disappear when consciousness cannot 'keep pace' with the 'required' development of consciousness. It seems like an effect from a 'higher' plane: something that demands widening of consciousness.[869] This 'something higher' corresponds to Jung's concept of the *Self*, which is the self-organizing principle of the psyche. There is therefore a direct relationship between the state of consciousness of the subject and the Σ phenomena.[870]

Pauli wanted to place *the emotional experience of meaning and involvement, i.e. the affective factor,* at the centre of the Σ concept. He returned to this in connection with his interest in the parapsychological experi-

[867] Pauli to Jung, 12 Dec. 1950 [47P], *PJL*; Pauli to Fierz, 25 Dec. 1950 [1188], *PLC IV/1*.

[868] Pauli to Jung, 28 Jun. 1949 [37P], *PJL*. He relates this balance of opposites to the hexagram 'Chen' (shock, thunder, no. 51) in the *I Ching*. In Pauli's case he apparently experienced synchronicity especially on the equinoctial days, when night and day 'balance' each other.

[869] Conversation between Wolfgang Pauli and Hans Bender on April 30, 1957. See Appendix to letter [2586], *PLC IV/4i*. He actually here states the opposite to what Jung writes in his essay *On the Nature of the Psyche*, where he states that synchronistic manifestations dissapear when unconscious contents become conscious. Pauli says that they dissapear when they remain unconsious. Jung, 'On the Nature of the Psyche', *C.W.*8, §440.

[870] Pauli proposed to include radioactivity as an example of the same kind of process occurring in matter. From a 'neutral' perspective radioactivity also consists in the transition of an unstable initial state of the atomic nuclei of the active substance into its stable final state whereby the radioactivity eventually ceases. Pauli to Jung, 28 Jun. 1949 [37P], *PJL*.

ments which were being conducted in various parts of the world at this time: by J.B. Rhine at Duke University and R.A. McConnell at Pittsburgh University, both in the USA, and by S.G. Soal and F. Bateman in England. What was interesting to Pauli was that they showed positive results – over the statistical average – when the experimental subject was emotionally *involved* and expected something from the experiment. This was often the case at the start of the study, whereas the result deteriorated – reverted towards the statistical average – as more experiments were conducted. The subject began quite simply to be bored by the experiment. This phenomenon was given the name of 'fatigue (decline) effect' (*Ermüdungseffekt*). Pauli also called it *the pernicious influence of the statistical method on the synchronistic phenomenon*. In a conversation 1957 between Pauli and Hans Bender, holder of a chair of parapsychology in Germany, Bender confirmed the importance of the affective factor in the investigation of so-called parapsychological phenomena.[871]

The same principle, i.e. strong *feeling* or *involvement* as an ordering factor, had been in action in the astrological experiments which Jung conducted in the course of his work on synchronicity. Jung had presumably intended to show that astrology is based on some kind of acausal connection between its symbol system and people born at particular times. Instead his astrological experiments resulted in a demonstration of the effect of synchronicity in the *researcher* and his *interest* in or expectation of a particular *research result*. For Jung observed that at the beginning of his experiment he obtained a result which statistically confirmed the predictions of astrology, but as material accumulated it evened out into a non-significant, statistically average result.[872] Pauli was rather surprised that Jung did this 'experiment' at all. To him it was obvious that one cannot establish synchronicity by a statistical method. He was therefore extremely satisfied that Jung had reached the conclusion that the statistical method erases all trace of the confirmation that had at first been expected. Pauli discusses this in a letter to Markus Fierz.

> The news in your last letter that C.G. Jung's results concerning the aspects 'typical of marriage' in the horoscope fell entirely within the bounds of statistically predicted variation is to me a source of unmitigated satisfaction. A test of this kind, in which every irrational factor is eliminated and the unconscious has no chance to operate (a comical thought that we physicists of all people have to draw the

[871] Conversation between Wolfgang Pauli and Hans Bender on April 30, 1957. See Appendix to letter [2586], *PLC IV/4i*.

[872] The experiment consisted in collecting horoscopes of married couples in order to see whether certain, according to Jung, traditional astrological constellations of sun and moon actually occurred in a majority of the married couples. Jung, 'Synchronicity: An Acausal Connecting Principle', *C.W.*8, §872 f.

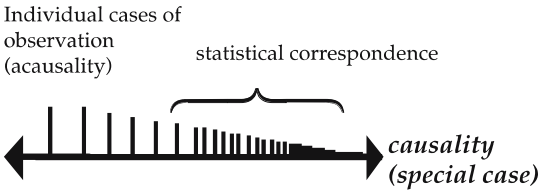
> attention of the psychologists of the unconscious to this!) cannot turn out in any other way! The sciences are quite good enough to predict the negative outcome of *such* an attempt, and it was only the product of a mind quite without scientific training to expect anything else from it! For here we are concerned with the reproducible and not with the unique. It is about the latter that statements are possible which are additional to the scientific conclusions, but without invalidating them. (I use 'the unique' so broadly as also to include isolated *groups* of events, not only single events.)[873]

The relationship between what the synchronicity principle seeks to describe and what one may arrive at using a statistical method is a true complementarity relationship. The statistical measurement excludes precisely what synchronicity emphasizes: the mental state of the observer. Therefore this ought to be included as an essential part of the definition of the synchronicity concept. Pauli formulated this as follows:

> It actually seems to me a general and essential attribute of synchronistic phenomena, one that I would even like to incorporate into the definition of the term 'synchronicity'; in other words, whenever an application of statistical methods, without consideration of the psychic state of the people involved in the experiment, does not show such a 'pernicious influence', then there is something very different from synchronicity going on.[874]

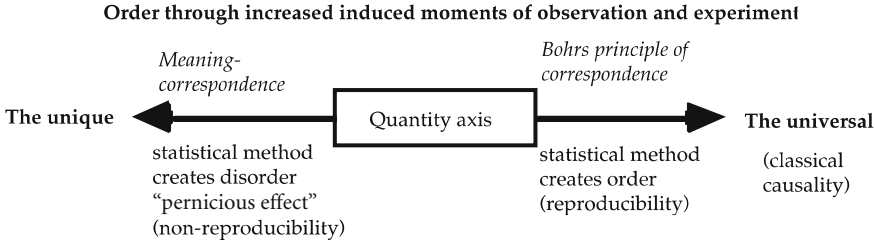
If there is one thing that Pauli has learned from quantum physics, it is that the statistical character of the laws of nature is the price that has to be paid in order to maintain reproducibility in physics. In other words the statistical method saves science from the detested, isolated, non-repeatable instance: it can be placed in brackets. By increasing the amount of measurements of individual cases one obtains a total statistical picture which approaches the result of the classical theory. The area where the results of quantum theory merge with the predictions of classical physics is labelled statistical correspondence. From the point of view of quantum theory classical causality is regarded as a special case within the framework of general probability calculation. This might be illustrated as follows:

The correspondence principle



[873] Pauli to Fierz, 20 Mar. 1950 [1091], *PLC IV/1*.
[874] Pauli to Jung, 24 Nov. 1950 [45P], *PJL*.

In physics it is the statistical method that creates the connection – establishes order – by mediating between discontinuum and continuum. Synchronicity or *meaning-correspondence*, as Pauli prefers to call it, consists of an individual, unique situation that displays correspondence between the psychic and the physical situation which is experienced as meaningful. Here the statistical method has the reverse effect: it erases and destroys the connection, the experienced order, which was perceived in the individual case (as well as in isolated groups of events).[875] We thus obtain an axis of quantity, where an increase in the number of experiments in the one case (the correspondence principle of physics) gives an increased explanatory value (greater order and correspondence) – whereas in the other case (Σ) we obtain a reduced explanatory value, in other words an eradication of the correspondence.



Order through quantity

Statistical correspondence stands in a complementary relationship to meaningful correspondence and therefore one can never state a contradiction between synchronicity and causality. It would have been totally inconsistent if it had been possible to confirm the synchronicity principle by means of a statistical method. From the point of view of synchronicity statistical correspondence is remarkably close to classical causality and has to be regarded as a very weak generalization of it. It is true that quantum physics contains the acausal approach, but it has no use for a term like 'meaning'.[876] The parallel, on the other hand, which exists between the Σ phenomena and the correspondence principle in physics is '*the co-ordination of the behaviour of different* (deterministically and causally unconnected) *events*. (On this of course rests the concept of 'physical situation' in quantum mechanics, *not* on a direct reciprocal influence of the objects concerned.)', asserts Pauli.[877] In accordance with the correspondence principle Pauli considered it necessary to deal with the Σ phenomena on different levels, or possibly

[875] Pauli to Fierz, 20 Mar. 1950 [1091], *PLC IV/1*.
[876] Pauli to Jung, 24 Nov. 1950 [45P], *PJL*.
[877] Pauli to Fierz, 26 Nov. 1949, [1058], *PLC III*, 710.

to perceive them as on a scale where one end represents a special case of a more general context. Even among acausal phenomena one has to distinguish between the unique, non-constant and spontaneous and the constant and reproducible. It is therefore doubtful whether one should, as Jung does, count the relationship between body and soul as a connection based on the synchronicity principle, as these two stand in a relatively stable relation to each other.

Jung had also postulated that mantic methods or divination (the art of prophecy) could be based on a relationship of synchronicity between an internal state and the external pattern which is formed by the equipment used by the diviner – such as randomly thrown coins, bones, sticks or cards drawn from a well shuffled pack. However this postulate is based on the assumption that synchronicity is constant and can be *induced* with the aid of a special forecasting method. Pauli compared this idea with two historical theories dealing with this general set of questions.[878] Both Leibniz and Schopenhauer had assumed a constant psychophysical parallelism between the inner and the outer world. Leibniz assumed what he called a preestablished harmony, a harmony predetermined by God between the fundamental elements of existence. This harmony ensures that these elements or *monads* will accompany each other in their individual process of development, like synchronized clocks, without reciprocal relations. In Schopenhauer's essay *On the Apparent Design in the Fate of the Individual*, Pauli found a precursor of Jung's idea of synchronicity. He drew Jung's attention to this text and observed that this essay had exercised a lasting and fascinating effect on him. Here Schopenhauer develops the idea of an ultimate union of necessity and chance, which reveals itself to us as a '. . . ›force‹, ›which links together all things, even those that are causally unconnected, and does it in such a way that they come together just at the right moment‹.'[879] Schopenhauer imagined the causal chains placed alongside meridians of time while simultaneity would be kinds of parallel latitudinal circles of events, crossing the meridian of time in a sort of junction of coincidence.[880] In contrast to these ideas of a constant parallelism were those of the occasionalists, represented by Arnold Geulincx. Geulincx was a pupil of Descartes and was in fact the originator of the theory that body and soul function as two synchronized clocks. But unlike Leibniz, who considered that God had established harmony between body and soul once and

[878] Pauli to von Franz, 12 Nov. 1949. See also Pauli to Fierz, 26 Nov. 1949 [1058], *PLC III*, 710.
[879] Pauli to Jung, 28 Jun. 1949 [37P], *PJL*.
[880] Arthur Schopenhauer, 'Über die ausreichende Absichtlichkeit im Schicksale des Einzelnen', *Parerga und Paralipomena* I, 243.

for all at the beginning of time, Geulincx believed that God made continuous interventions in the universe by *acts of creation*, to which he gave the name *true* causes.

There is a difference between assuming a constant psychophysical parallelism and assuming a spontaneous, creative act that transcends psychophysical boundaries. To Pauli it was important to distinguish between a spontaneous appearance of synchronicity, as in Jung's example of the beetle, and the *induced creation* of synchronicity as in the case of mantic methods (divination).[881] Pauli thought he could see certain parallels between the induced form of synchronicity and the arrangement of a scientific experiment. The *creation* of a synchronistic situation is achieved by a certain 'preparation of the experimental situation'. Where divination is concerned, this 'preparation' consists in ritual behaviour, where the material process (throwing coins etc.) is brought in as a mediating link between 'the object examined' (the person whose fortune it is desired to foretell) and the intuitively gifted 'observer'. Pauli imagined that by means of this mediating link – the ritual behaviour and the ritual equipment – one triggers a subliminal process which has a meaningful connection (Σ) with the 'object' which the intuitively gifted person can interpret by introspection. The essential difference as compared with a scientific experiment is that it is attempting to reproduce not an external process, but an existing – previously postulated – synchronistic connection between 'observer' and the 'observed system'. In science a similar process takes place when it comes to the actual *discovery* of a natural law. Such a discovery requires either an intuitive gift, or a coincidence of an internal image and an external process. Once the natural law has been discovered and formulated, it is found that the conditions for its use allow reproducibility. An automatic agreement arises between our expectations and the experimental results – i.e. 'reasonable belief'. The framework of the natural law however demands reproducibility, and therefore a surrender or *loss of the unique*. Pauli asserted that in both quantum physics and divination one makes predictions about the non-repeatable individual case by 'feeling one's way into the direction

[881] Jung also included another kind of 'induced' synchronicity, a kind that emerges when the person is 'in order' or stands in a receptive relationship to the Self, a state of balance and wisdom, also called *Tao* in Chinese philosophy. This kind of synchronicity is exemplified by the story of the Rainmaker told by Jung's friend the sinologist Richard Wilhelm. It is about a village who called upon a rainmaker during a drought. This man stayed outside the village in a hut meditating and on the fourth day the rain came. When asked how he had managed to make the rain he answered that he came from another country where things were in order. In this village they were out of order; they were not as they should be by the ordinance of heaven. Therefore, the whole country was not in Tao and he had to wait three days until he was back in Tao and then naturally the rain came. By being in order oneself, the inherent order of the outside world emerges. Jung, 'Mysterium Coniunctionis', *C.W.*14, §604, footnote 211.

of the process' – in quantum physics, moreover, this feeling of direction is confirmed, because it corresponds to the predictions of the more exactly defined classical framework. The *spontaneous* emergence of synchronicity on the other hand must be seen as something other than an existing situation which one can 'feel one's way into'.[882]

Pauli turned to Jung with these objections and asked for a stricter definition of the Σ concept.[883] Not entirely unexpected, Jung replied by *broadening* the concept instead. He said that synchronicity may be regarded as an act of ordering (*Anordnung*) by means of which 'similar things coincide, without there being any apparent cause'. The constellation of which Jung speaks is bound up with the essence of the archetype; it is relative to time, space, mind and matter. Like Schopenhauer and Kant, Jung considered that time and space belong to the world of phenomena, that is to say the world which forms our conscious frame of reference. As a result, the unconscious must be relatively independent or autonomous in relation to these categories. This definition of the collective unconscious or the objective psyche is of course a prerequisite of the archetype theory. Synchronicity may therefore be described as an expression of a *constellated* or activated archetype. However the archetype must not be seen as 'causing' the constellation, any more than the hexagonal structure of the snowflake 'causes' the appearance of the individual snowflake. The archetype 'in itself' has nothing at all to do with a visual or known structure; it is rather a 'possibility of structure', which in addition contains an affective or qualitative element rather than an abstract geometrical one. This way of reasoning was sympathetic to Pauli. The non-visual, ('void') unified psychophysical reality acts by *constellation* and not as a 'cause' and this unity manifests itself as a consequence of a process of conjunction (reconciliation of opposites).[884] With the concept of 'constellation' Jung had moved away from the platonic notion of the archetype being 'inborn' or situated as an ideal form in some sort of 'space'. Pauli emphasized this difference in 1957 in a taped conversation with Hans Bender, professor of parapsychology at Freiburg. The archetype should not be seen as an 'inborn structure' lying 'latent', just waiting to manifest itself, but as something that *constellates*, or *emerges* at certain stages and situations in life.[885]

[882] Pauli to Fierz, 20 Mar. 1950 [1091], *PLC IV/1*.

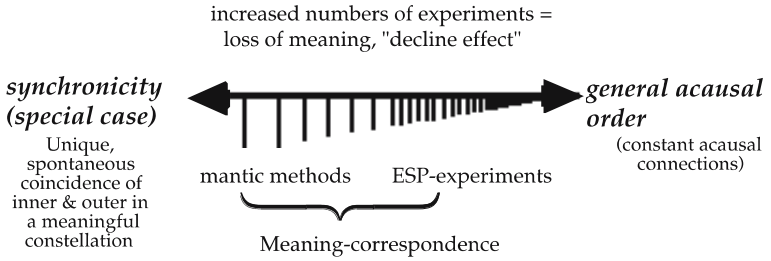
[883] Pauli to Jung, 24 Nov. 1950 [45P], *PJL*.

[884] Pauli to Jaffé, 25 Sep. 1951 [1284], *PLC IV/1*. This reality is void in the sense that it escapes visualization in images or words.

[885] Conversation between Wolfgang Pauli and Hans Bender on April 30, 1957. See Appendix to letter [2586], *PLC IV/4i*. With this standpoint they come close to the theory of 'emergent property' that we find today in dynamic system theory. See for example Hendriks-Jansen, H., *Catching Ourselves in*

Synchronicity depends, according to Jung, on the relativization of time and space when the archetype in some form 'breaks' into or manifests itself in our everyday world. Jung wondered whether all states of being that have no conceivable cause – nor any possible, as yet undiscovered, cause – might not be summarized under the category of synchronicity. There is no reason to limit the definition of the Σ phenomena to the mental state of the observer. It would be possible to include all acausal occurrences, both the coincidence of two mental states (telepathy), the coincidence of a mental state and a physical event (the beetle example) and also acausalities in physics, such as the half-life of radioactivity. If the psychic component is involved, the term *meaning* (*Sinn*) is used to designate it as a special case of the more general phenomenon *similarity* or *correspondence*. The psychic and half-psychic Σ cases and the non-psychic discontinuities may be seen as different sub-divisions of a general acausal order. In this case the relationship between body and soul may also be included as a phenomenon which comes under the heading 'general acausal order'.[886]

This might be illustrated as follows:



Synchronicity

Despite some misgivings, Pauli was interested in Jung's broad definition of synchronicity. The reason for this was that by broadening the definition Jung was moving in the direction which had always appeared ideal to Pauli: a summary of psychophysical reality. The concept of synchronicity would in this way cover all acausal, or, more correctly, all unified, no longer reducible, constellations or systems. Pauli saw it as entirely consistent with scientific thinking to summarize specific occurrences under a more general concept. The risk of this procedure might however be that the characteristic phe-

the Act: Situated Activity, Interactive Emergence, Evolution, and Human Thought (Cambridge, MA: MIT Press, 1996) and McDowell, M. J. 'Principle of Organization: A Dynamic-Systems view of the Archetype-As-Such'. *The Journal of Analytical Psychology, 46*(4) (2001), 637–654.

[886] Jung to Pauli, 30 Nov. 1950 [46J], *PJL*.

nomenology which is associated with the psychic factor would be lost in such a broad definition. The difference already referred to between the unique and the meaningful in the one case and the general and 'meaning-neutral' in the other, risks being obliterated. A further problem is that one cannot merely transfer the concept of the archetype to the acausalities of microphysics. If one wishes to use the broad definition of synchronicity one must define the general case that includes the ordering function of the archetype as a special case. At the heart of the comparison between the acausalities of microphysics and synchronicity, the scientific laws of probability stand in opposition to the archetype as an ordering factor. Pauli considered that Jung absolutely had to stress this difference in his work on synchronicity.

After much pondering Pauli accepted the broader definition of synchronicity. It points forwards towards a unified view of the world and this may therefore be given priority over the fact that many of the detail questions must still be clarified. Above all, the concept of the archetype has to be expanded, to make it possible to apply to the field of microphysics.

> Bearing this in mind, I have once again carefully weighed up the pros and cons of the narrower and broader definitions of 'synchronicity.' Pure logic gives us a free hand to choose either definition. In such a case, the deciding factor is intuition, pointing the way to the future as it does, but this is psychology and the branch of psychology that I am particularly interested in – namely, the scientific formation of concepts. With me, the intuitive function has such a strong tendency toward the apprehension of holistic structures that despite all arguments to the contrary, I find myself leaning toward your *broader* definition: Given the impossibility of a direct application of the term 'archetype' in microphysics, I am more inclined to believe that the present term 'archetype' is inadequate rather than that your *broader* definition is in itself inappropriate. For since your essay in the 1946 Eranos-Jahrbuch [see Letter 37, n. 1], it seems to me that the term 'archetype' is going through a phase of great change at the moment, and my intuition leads me to expect further modification of this concept in the future. What is of consequence here is that several other important concepts are being applied in both psychology and physics without that having been specifically so intended: similarity, acausality, ordering, correspondence, pairs of opposites, and wholeness.[887]

That the archetype as ordering factor would correspond to the probability concept of mathematics was very enlightening to Jung. Jung realized that *the archetype concept forms a probability model for the appearance of a particular psychic process under certain specific circumstances*. One may, for example, take it as very probable that a confused and unbalanced individual will produce compensatory mandala-like patterns.[888] The archetype thus represents

[887] Pauli to Jung, 12 Dec. 1950 [47P], *PJL*. Translation altered by the author.
[888] Jung to Pauli, 13 Jan. 1951 [49J], *PLJ*. C.G. Jung, 'The Psychology of the Transference', *C.W.*16,

a symbolical anticipation of the results of psychic statistics, which is most evident in the tendency of the archetype to keep reproducing and confirming itself. Jung acknowledged that Pauli was right in saying that the archetypal concept needed to be further developed before a closer association between natural science and psychology would be possible. At the same time he saw a fundamental difference.

> I am, of course, very pleased that you have indicated your inclination to consider seriously the extension of the Σ theory. Under these circumstances, you are fully justified in demanding a new interpretation of the term archetype. It seems to me that the way to achieve this is via the analogy archetype-probability. In physical terms, probability corresponds to the so called natural law; psychically, it corresponds to the archetype. Law and archetype are both modi and abstract ideal cases that occur only in modified form in empirical reality. My definition of the archetype as 'pattern of behavior' accords with this interpretation. But whereas in the sciences the law appears exclusively as abstraction derived from experience, in psychology we encounter an a priori existing image, already complete as far as can be judged; this image occurs spontaneously, in dreams, for example, and possesses an autonomous numinosity, as if Someone had stated in advance with great authority: 'What is coming now is of great significance.' This strikes me as being in sharp contrast to the a posteriori character of the natural law. If that were not so, one would have to assume that the image – for example, of radioactivity – had always been present and that the real discovery of radioactivity (in this case) would simply be this particular image becoming conscious. The way you deal with the image of the lapis raises the question for me of whether ultimately the symbols accompanying the lapis, such as the multiplicatio do not indicate a transcendental basis common to both the physical and the psychic. So although everything seems to indicate that radioactivity and its laws are something perceived a posteriori, it is nevertheless fundamentally impossible to prove that the natural law is actually based on something toto coelo different from what we in psychology call archetype.[889]

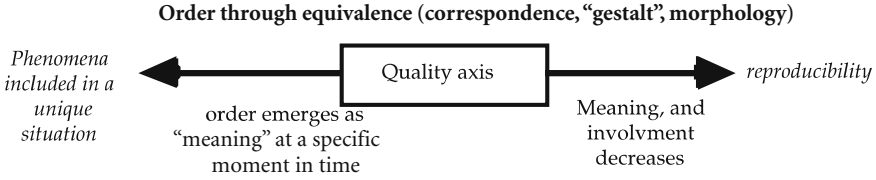
How shall one then understand the relation between the acausality of physics and archetypal order? Should psychic (archetypically determined) synchronicity be seen as a sub-division of general acausality or should acausality be seen as an effect of archetypical order? The latter gives a Platonic worldview with a *mundus archetypus* as a model. With the first perspective, on the other hand, both synchronicity and acausality appear as anomalies in relation to general causality. Jung was convinced that general acausality must be the more general factor, while the archetypal order may be considered a special case. The archetypical order is characterized by the fact that the observer, so to speak, obtains an insight into an order which normally appears *non-transparent* and 'random'. The general case would therefore consist of an acausal state

§535–36.

[889] Jung to Pauli, 13 Jan. 1951 [49J], *PJL*.

of affairs, whereas the special case would be a *transparent* 'so-ness' situation, i.e. one in which *meaning* can be observed. Perhaps this means that we have to postulate a new type of natural law, one based on some sort of *qualitative, forming factor* of synthesizing and gestalt-creating character – a law which acts both in physical nature and in the human psyche. This natural law cannot be determined from a model which is based on reproducible experiments, for it expresses itself in uniquely qualitative moments in time. We might thus obtain an axis of quality, in which an event can only be explained by including the unique situation and context in which it has arisen. It has to be seen in the light of the situation as a whole, in other words by considering the *gestalt* or *quality* of the situation. The different components in the situation are linked by the fact that they point to a common underlying factor, which has to do with this specific quality. This factor may for instance be characterized by 'meaning' or 'purposefulness'. Such a 'qualitative' order excludes the type of order which can be confirmed with the aid of reproducibility.

When Jung sent the revised version of his work on synchronicity to Pauli at the beginning of 1951, Pauli was very pleased with Jung's concluding chapter on the relationship between synchronicity and the scientific worldview. They decided on a joint publication. In a letter to Markus Fierz attached to a copy of the book Pauli says that he feels pleased with Jung's device of using general acausality as a frame of reference for the relationship between the laws of physics and synchronicity. Earlier models of psychophysical parallelism, such as the versions of Leibniz and Spinoza, have always assumed a determinist approach. Pauli mentions the point of view that among some physicists quantum physics is considered *incomplete* because it cannot preserve the determinism of classical physics. But quantum physics is only incomplete if one presupposes a determinist framework! One might equally well say that phenomena such as quanta and synchronicity show that the classical worldview is incomplete. Scientifically it is more satisfying to position the acausal correspondence as general principle. This was just the way Bohr had argued;



Order through quality

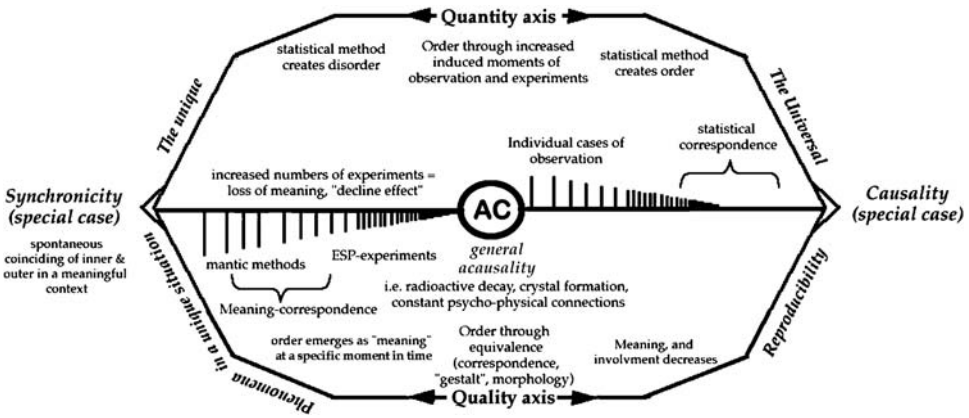
the acausality of quantum mechanics forms a generalization of the narrower causal framework which is seen as a special case of statistical correspondence. Pauli wanted similarly to see psychophysical correspondence (Σ) as a special case of the general 'reproducible and self-reproducing acausal orderedness' which includes both the acausalities of quantum physics and the manifestations of the archetype.

> For if everything is determinist-causal, there is in my opinion no room for another kind of correlation, which might be designated 'parallelism' rather than 'causal'. Hence the existence of the wisp of intellectual mist which has been christened 'psychophysical parallelism' is just as much a pointer to the incompleteness of the classical-scientific worldview as for example the photoelectric effect and the quantum of action. It is therefore more satisfactory to me to think that there must be an *acausal* kind of correlation that is called 'psychophysical parallelism' qua 'arrangement' or 'correspondence' *as well* and not just only concerning the psychophysical. C.G. Jung has tried to link the psychophysical correlation with his synchronicity phenomenon (abbreviation Σ) (see footnote 2, p. 85/86). But in doing so a fundamental difficulty arose, which I have particularly pointed out and which Jung has since (p. 103 and 104) taken particular note of: the synchronicity (Σ) phenomena in the narrower sense which he considers, refuse to be captured by *laws* of nature, for they are not reproducible, i.e. are unique, and are lost in the statistics of larger numbers. In physics, on the other hand, the 'acausalities' are immediately *ascertainable* through statistical laws (large numbers). Moreover not only all psychophysical contexts but also such empirical facts as the remote senses of many animals (migrating birds etc.) are fully reproducible, always present, so to speak, and in a certain sense also the effects indicated by Rhine, which in fact *become evident* through statistics where there are large numbers. (N.B. Jung's astrological enterprise in Chapter II seems to me totally unsuccessful.)
>
> A degree of uncertain wavering enters into Jung's conception of the Σ phenomenon in that he sometimes considers the reproducible, sometimes the non-reproducible and individual. (N.B. I would sooner call the first Σ phenomenon in the narrow sense 'meaning-correspondence' rather than 'Σ' *without* explicit emphasis of the temporal concept). To me personally it would be greatly preferable to begin with always *reproducible* 'acausal orderedness' (including that of quantum physics) and to try to conceive of the psychophysical connections as a special case of these general species of correlation (as indeed Niels Bohr tried to do).[890]

The final outcome of the discussions between Pauli and Jung was the hypothesis of a *general acausal principle* with two extreme ends in the form of two special cases and a sliding scale between them. The general acausal principle confirms only the existence of Causeless order. It is regular and accessible via statistical method. Examples of this type of acausal order are all constant psychophysical connections (such as the relationship between body and soul), the acausalities of quantum physics, crystal formation in chemical solutions and so on.

[890] Pauli to Fierz, 3 Jun. 1952, [1417], *PLC IV/1*; Laurikainen, 141–42.

If we put our previous images together the following picture would emerge:

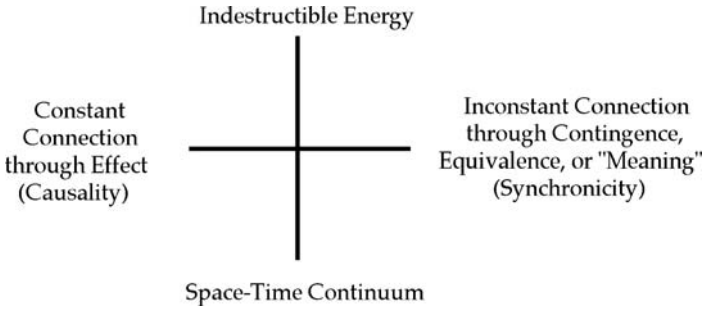


Causality, acausality and synchronicity

At one extreme of general acausality we find strict causality as a special case, in other words occurrences with a very high and exactly determinable reproducibility. Its conformity to law is based on quantitative regularities. At the other extreme we find a special case in the form of synchronicity which is characterized by its unique, creative nature. The key to these phenomena is the experience of purpose, meaning or *numinosum* on the basis of the relatively simultaneous appearance of both inner and outer events. Internal state and external events seem to fall into place in a greater pattern which is perceived as meaningful. Such an experience always implies something qualitatively new – a qualitative leap if one will – and represents the *rubicon* of individual life. Jung therefore described such phenomena as creative acts in time in keeping with the *creatio continua* of Origen or Augustine, i.e. an eternally present act of creation.[891] At this extreme one may therefore also consider placing all unique creations in the universe, even those which are not observed by a psyche. The remaining problem for Pauli was the relation of the unique to the general and the reproducible. Pauli described the qualitative difference as follows: general acausality is an *acausality without purpose* or aim – it is merely an observable fact – whereas unique synchronicity constitutes phenomena which display an apparent purpose.[892] The finished work also contained

[891] Jung, 'Synchronicity: An Acausal Connecting Principle', *C.W.*8, §965 f.

[892] There seem to be certain parallels between Pauli's and Jung's reasoning concerning the Σ principle and modern chaos theory: 'The system is deterministic, but you can't say what it's going to do next. At the same time, I'd always felt that the important problems out there in the world had to do with the



Pauli's and Jung's worldview quaternio

the diagram which shows a more complete worldview than the classical deterministic one, a diagram which Pauli and Jung devised together. The three known principles of science – energy, space-time continuum and causality – are supplemented with a correspondence principle, in other words with the principle which creates connections by similarity, contingence, coincidence, meaning and purpose.[893]

Pauli's decision to publish his Kepler essay together with Jung's work on synchronicity represented a clear statement of his position. He saw the final chapter of the essay on synchronicity as *Jung's spiritual testament*. In this chapter, on which they had both co-operated, Jung gets beyond analytical psychology, into natural philosophy in general and psychophysical problems in particular.[894] When asked how his colleagues reacted on his joint publication with Jung, Pauli answered that they thought it was a mistake to publish his work on Kepler with Jung's 'unreadable' essay on synchronicity.[895] But Pauli felt that they belonged together. Their being published together symbolized a first attempt at a unified worldview, where the physicist goes into psychology in order to understand the development of his own science and the psychologist is forced into the world of physics to find parallels with his own discipline's discovery of psychophysical connections. For that reason Pauli was not willing, despite repeated enquiries, to publish his Kepler essay separately from Jung's work on synchronicity. This was not because he needed

creation of organization, in life or intelligence. But how did you study that? [–––] I always felt that the spontaneous emergence of self-organization ought to be part of physics. ›Here was one coin with two sides. Here was order, with randomness emerging, and then one step further away was randomness with its own underlying order.‹', James Gleick, *Chaos-Making a New Science* (New York, 1987), 251–52.

[893] Jung, 'Synchronicity: An Acausal Connecting Principle', *C.W.*8, §963. See also Jung to Pauli, 30 Nov. 1950 [46J], *PJL*.

[894] Pauli to Fierz, 3 Jun. 1952, [1417], *PLC IV/1*; Laurikainen, 142.

[895] Conversation between Wolfgang Pauli and Hans Bender on April 30, 1957. See Appendix to letter [2586], *PLC IV/4i*.

to be loyal to Jung but because he – as he himself put it – was compelled to be *loyal to the unconscious*. It would be an offence against the demands of his inner life, an insult to 'the stranger' if one will, to publish the essay independently of Jung's. The essays ought to be published together or not at all – and that despite the fact that Pauli was not satisfied with some aspects of Jung's work. These particularly concerned the astrological experiment which he considered unnecessary and which only encouraged a lot of erroneous interpretations by believers in astrology who saw Jung's experiment as support for astrology.[896]

> Many physicists and historians have of course advised me to break the connection between my Kepler essay and C.G. Jung in the English translation. On mature reflection however I have *still* decided *not* to do so: it is *not* important to be entirely loyal personally to C.G. Jung (and not so important to him either). *But it is very important to remain loyal to my own unconscious*. This presents me constantly with something that it calls 'radioactivity', which roughly coincides with what Jung calls 'synchronicity'. I am indifferent to the astral cult of Jung's circle, but that, i.e. this dream symbolism, *makes an impact! The book is itself a fateful 'synchronicity'* and must *remain* one. [–––] I am sure that defiance would have unhappy consequences as far as I am concerned.
> Dixi et salvavi animam meam![897]

[896] Pauli's attitude to astrology was very negative. He could accept the Chinese oracular method I Ching and was open to parapsychological phenomena. But astrology was anathema to him. He acknowledged in a letter to von Franz that his reaction against astrology went far beyond what was rationally justified and could not be supported with relevant arguments. 'Here to me only one problem is relevant. I-Ching appeals to me instinctively, and I willingly accept synchronicity on the strength of my own experience, but – I have an instinctive dislike of horoscopes which goes far beyond the rational.[1] With a horoscope I feel like a cat whose fur is being rubbed the wrong way, or like a physicist who is faced with an apparatus with a fundamental design fault (see below!).[1] For example, Mrs Carry Baynes asked me after my Kepler paper in Princeton (1950) why I so totally reject astrology when I accept the I-Ching and synchronicity. – I could only stammer out something, I did not know the true answer. But nothing altered the fact.' Pauli to von Franz, 12 Nov. 1953 [1672], *PLC IV/2*. Nevertheless a horoscope was made for him and is deposited as an appendix to a letter to Jung on 23 December 1953 at the ETH, WHS Hs. 1056:30880.

[897] Pauli to Fierz, 25 Dec. 1954 [1953], *PLC IV/2*. 'I spoke and thus saved my soul.'

Unique Creation: Biology, Automorphism and Mathematics

In late 1951 and early 1952 Pauli began to review his 'taoist' position. The reassessment was connected with the fact that he was becoming increasingly interested in the individual act of creation and the unique development throughout history. He observed that the taoist position – however much it appealed to him – to a large extent reflects a *static* worldview. It postulates that there is a cosmic order with which man must learn to live in harmony, but there is never any interaction between this order and human consciousness. This philosophy had initially appealed to Pauli because it was free from logical contradiction and symmetrical. An alternative position now began to shape itself in Pauli, a position which he called the *interactive* or *evolutionary* model. It is based on an interaction between human consciousness and the non-visual order, and assumes a direction or evolution of cosmos in which consciousness plays an important part.[898] Lao Tse's view was perhaps better suited to the intuitive worldview of the Chinese than to Western science and its perceptions.[899] Traditionally there have been two versions of the evolutionary perspective: one visualizes the world arising and perishing in a regular cyclical process; the other sees the process as linear, the world has come into being once and is developing towards a final condition. Both models are plausible and it is impossible to decide on objective grounds which of them is the more correct.[900]

Pauli wanted to find a way to integrate the unique event, the creative moment, in the description of nature. To Pauli a true and real act of creation could not be compatible with the idea of a kind of 'consciousness' behind the scenes. To assume an 'omniscient' God goes against the basic idea of creation and gives a false picture of the cosmos. A true act of creation must be unique and autonomous and cannot therefore be 'foreseen', 'influenced' or 'caused' by any power.[901] Pauli was convinced of the existence of a *limited* regularity in nature which was closely associated with his scientific worldview and in particular with his view of the relationship between classical and

[898] Pauli to Jaffé, 3 Dec. 1951 [54P], *PJL*.
[899] Pauli to Jung, 27 Feb. 1952 [55P], *PJL*.
[900] Pauli to Jung, 17 Jun. 1952 [56P], *PJL*.
[901] Pauli to von Franz, 22 Dec. 1951 [1328], *PLC IV/1*.

modern physics. This conviction was further reinforced as Pauli's interest in biology grew. He was particularly concerned with the concept of *chance* in the Neo-Darwinian theory of evolution. Random mutations as an explanation of natural selection seemed untenable to Pauli, especially because he, like Jung, thought that the word 'chance' was usually used to fill the gaps in an inadequate knowledge. Admittedly Pauli was aware that he was only a layman in the biological sphere, but he devoted a lot of time around 1953 and onwards to obtaining information in the field and he talked a lot to biologists and to physicists with an interest in biology. In particular he talked to Max Delbrück (Nobel Prize for Medicine in 1969), a biologist who had begun as a physicist in Niels Bohr's circle but later 'emigrated' to biology. The discussions became quite heated, because their ideas differed considerably.[902] Pauli also took up the subject with several of his colleagues, including Heisenberg, Bohr, Jordan and Victor Weisskopf. This is what Pauli says on the subject to Bohr (originally written by Pauli in English):

> One of the most interesting articles I have studied is one of C.H. Waddington; 'The evolution of adaptations' in the periodical ENDEAVOUR, 12, 134, (1953). The author, Professor in Edinburgh, belongs to those biologists who admit that there is something essential still missing in our understanding of evolution. I also read several articles and one book of the geneticist *R. Goldsmidt*, who, deviating from the current view, assumes the occurrence of bigger sudden jumps, called by him 'systemic mutations', 'macromutations', or 'saltations', which should be responsible for the biological evolution. I was, however, not convinced by this particular story, because these bigger jumps, if not deadly, seem to me much too unlikely to be explained by 'chance' (a favourite word of all the Darwinists which they use in a very loose and superficial way), except if these big changes would be more or less continuously preceded and prepared by a series of other small changes, which are not externally visible. With the latter idea I approach your own hypotheses 'that also the genotype can undergo gradual secular changes of a kind, which serves a purpose of the adaptation to the environment' (p. 2 of your letter). Nevertheless not only the word 'gradual'; but also the word 'secular', here used by you, seem to me open to a critical discussion. Regarding the latter, one has to bear in mind that the natural unit of time in biology is the number of generations, which for a given time is so different for different species, rather than the physical time. If the effect of small changes of the genotype considered by you actually exists, one should therefore expect that it would be much quicker and therefore also easier visible in organisms producing many generations in a relatively short time as, for instance, Drosophila or bacteria.
>
> On the other hand Robert Oppenheimer, as well as a few biologists, seem to think that the heredity on the way over the cytoplasma, which is much rarer than the usual one over the cell nucleus, is just the one which in the long run can give rise to directed processes reflecting hereditable influences of the environment.

[902] Victor F. Weisskopf, 'Meine Assistentenzeit bei Pauli', *Wolfgang Pauli: Das Gewissen der Physik*, 87.

> But, at present, the empirical material to support such a far-reaching assumption, is extremely scarce, if at all existing. Nevertheless this guess seems to be logically related to your remark, that 'in a living organism we are never dealing with the chromosomes alone, but that the smallest units… to be considered in connection with the propagation, are the cells' – a remark which seems to me to cover an essential part of the situation.[903]

Pauli considered that the Neo-Darwinists stuck to the theory of random mutations because they still clung to a scientific approach belonging to the late nineteenth century, one which was marked by a horror of all forms of finality. To be able to continue to exclude finality one had to replace it with 'chance'. Clearly this was a price that they were willing to pay. Pauli called this the *Chance-Religion* of the biologists.[904] They concentrate entirely on maintaining a causal model, which will explain every change in terms of a causal relationship between environment and gene. With this they miss the truly interesting question of the organism's inherent capacity for hereditary change. Pauli wonders, for example, whether there may be any inherent lines of development in the organism which are independent of the environment, lines of development which quite simply lie in the potential code of the organism.[905] As a physicist Pauli believed that the evolutionary model of Neo-Darwinism was in no way supported by any positive probabilistic consideration. One would have to compare the theoretical time scale of evolution that follows from the model and its empirical time scale. The comparison must be able to show that on the basis of the model it is possible to substantiate that the purposeful forms of life which exist today have had a chance to arise as a result of random mutations – within the empirically known time scale. According to Pauli, nobody has been willing to carry out such a study.[906]

> What is the probability of a reptile acquiring feathers in the course of 50 million years? This has actually happened, the archaeopteryx still has the bone structure of a reptile. Or: *what is the chance of* an animal the size of a dog gradually acquiring longer and longer legs[1] and hooves? This has also actually happened, for it is the evolutionary history of the *horse*. – Selection only ensures that the form with the longer legs, once existing, has when hunted by other animals the greatest chance of surviving and procreating. – The 'fittest' are in this case those who can run fastest.
>
> ([1]We know nothing at all about which chemical process in the genes corresponds to the length of the legs.)[907]

[903] Pauli to Bohr, 19 Feb. 1954 [1722], *PLC IV/2*.
[904] Pauli to Weisskopf, 23 Feb. 1954 [1725], *PLC IV/2*.
[905] Pauli to von Franz, 26 Mar. 1954 [1750], *PLC IV/2*.
[906] Pauli, 'Ideas of the Unconscious', *WPP*, 162. Such studies were made in the 1970s. See Enz, *No Time to be Brief*, 469.
[907] Pauli to von Franz, 26 Mar. 1954 [1750], *PLC IV/2*.

Pauli thought that by developing the framework of synchronicity it would be possible to arrive at a more satisfactory biological model. Biology is concerned with the same type of natural events as Jung had summarized in his Σ concept. It is neither a matter of determinism in the classical sense nor one of sheer chance as in the case of quantum physics. Instead we may be dealing with a *third type of natural law*, which is still unknown. Pauli returns to the insight that he has acquired in the course of work on Jung's synchronicity essay. The concepts of *statistics* and *chance* are fundamental. 'Where in biology do we find *chance*?', asked Pauli. Genetics works with statistical laws, just as quantum physics does. Max Delbrück had succeeded in drawing up statistical models using a quantum physics foundation for the occurrence of both spontaneous and experimentally induced mutations. He showed that once a genetic mutation had occurred, it was possible to make successful use of the physicochemical model in order to understand heredity.[908] Pauli's main interest was evolution, characterized by certain rare or unique historical events. Neo-Darwinism seeks to explain these as a combination of 'purposeless (random) mutations' and natural selection. This theory may be contrasted with that of Lamarck, who believed that the environment can give rise to purposeful and hereditary changes in the gene and thus produce adaptation. Neo-Darwinism thus postulates 'purposeless or blind chance', while Lamarckism assumes 'purposeful or directed chance'. Both models are causal, but it has proved necessary to reject the Lamarckian view that 'the function produces its organ', because it has been impossible experimentally to show that acquired characteristics can be inherited. To the criticism of the vitalists, that the failure of the experiments is due to lack of studies over sufficiently long periods of time, the Darwinians reply – with some justification – that time in biology has nothing to do with absolute time, but with the number of generations which the species produces over a given period. By experimenting with certain forms of life with a high rate of reproduction it ought to be possible to settle the question empirically. The statistical model permits the making of successful predictions once a mutation has occurred. But according to Pauli there is no good model for explaining the *origin* of successful mutations.

> One therefore has the impression that *the external physical circumstances on the one hand, and inherited changes of the genes (mutations) adapted to the former on the other hand, although they are not connected causally-reproducibly, have nevertheless occurred once meaningfully and purposefully as an indivisible whole, together with the external circumstances correcting the 'blind', accidental fluctuations of the arising mutations*'.[909]

[908] Pauli to von Franz, Oct. 1953 'Die Klavierstunde' [1667], *PLC IV/2*.
[909] Pauli to von Franz, Oct. 1953 'Die Klavierstunde' [1667], *PLC IV/2*.

The advent of a successful mutation is of course a unique event of a holistic character, a phenomenon which a purely causal model cannot handle. The relationship between the external physical circumstances (the environment) and the change in the genes in adaptation to it (the mutation) *cannot be explained causally, because it is a relationship which cannot be reproduced*. Pauli wanted rather to assume a new type of natural law, differing from both the Darwinian and the Lamarckian. A natural law which operates holistically, a law of simultaneity.[910] Synchronicity brings in a third way of functioning which could also apply to the phenomena of life: it consists 'in a correction of the fluctuations of chance by meaningful or purposeful coincidences of causally unconnected events.'[911] This third type of natural law might therefore be able to interpret biological evolution as a transition from unique, relatively rare, non-reproducible occurrences, to increasingly fixed phenomena within the framework of a new normal state, which can be studied with the aid of statistical methods. Just as synchronicity primarily appears when the psychological development of the individual has reached a point where change is required, so Pauli is inclined to see the unique moment of creation in nature as a boundary phenomenon. He saw evolution as analogous to the psychological developmental process: synchronicity is linked with a transition from an unstable state of consciousness to a stable one, when consciousness has expanded and a new balance with the unconscious has been established. When this has been attained the synchronistic phenomena disappear and the development of the personality takes a qualitative leap forwards. Thereafter the life of the individual returns to 'normal', that is to say a more or less stable everyday existence. Consistent with this, purposeful mutations arise as unique creations under certain specific 'boundary conditions', which then become 'fixed' within the framework of a new normal state. Pauli later suggested in a letter to Fierz that the relationship between the unique and the causal might perhaps be understood with the aid of the Möbius strip. For if one sees only a little piece of the strip, it looks as if it has both a front *and* a back. If on the other hand one sees the strip as a whole, it is clear that it has only *one* side. Pauli thought that the same relationship might apply to the unique Σ phenomena and causality. They appear to be mutually exclusive because we see only a portion of reality.[912]

Pauli thought that the motor behind evolution might be qualitatively significant conjunctions of mutation and environment. A new holistic form

[910] Pauli to Kröner, 20 Oct. 1953 [1657], *PLC IV/2*.
[911] Pauli to von Franz, Oct. 1953 'Die Klavierstunde' [1667], *PLC IV/2*.
[912] Pauli to Fierz, 5 Mar. 1957 [2555], *PLC V/I*. See also Fierz to Pauli, 2 Mar. 1957 [2554], *PLC V/I*.

arises and may perhaps even contain intrinsic lines of development which give the impression that the forms of life serve a purpose.[913] In connection with this Pauli wanted to discuss Jung's hypothesis that the archetypes constitute the *hereditary* deposits of the human race. This question is closely connected with that of how specific patterns of behaviour and instincts are acquired and inherited. Pauli believed that Jung's hypothesis of *unconscious or absolute knowledge* might be able to form the beginning of an alternative explanatory model of how acquired behaviour may be passed on from generation to generation – without it being necessary to fall back on the ideas of Lamarck.[914] *Absolute knowledge* is a factor which Jung links with the ability of the archetype to organize and convey information on an unconscious level. He referred in this context to the expositions of the biologist Adolf Portmann in this field.[915] Portmann argued that in biology it has been necessary to start talking again in terms of 'intelligence' or 'knowledge' in order to describe the highly complex instinct-provoking 'gestalts' or systems in the animal kingdom. Terms like *intelligence spécifique* (A. Vandel) or *unconscious knowing* (Portmann) had been used to designate the process which, for example, causes the certain female fritillaries first to check that there are violets under the tree in whose bark they lay their eggs, so that the caterpillars will be able to find the food they need the following spring. This *recognition* is based on supraindividual gestalt-like stimulus structures – not just any such, but very specific configurations – which trigger transformations or particular behaviour. In this case one may very well speak of images or forms as active transformers of vital energy. One may, albeit very cautiously, compare these with what Jung called archetypes. It must be noted that the differences need also to be underlined: the stimulus forms in the animal kingdom are external configurations which precipitate certain changes in the central nervous system that command a certain behaviour. Portmann calls this *extranes Wissen (extraneous knowing)*. In man the more highly developed nervous system appears to have reduced the conditioned regulation of the vital energy, in favour of a voluntary regulation. However what is most remarkable is that man produces such transformative forms from within himself. Therefore a distinction ought to be made between 'triggering effect' (*Auslöser-Wirkung*) and 'evocative effect' (*Evokator-Wirkung*). A 'triggering effect' primarily concerns inherited behaviour patterns which we to a greater extent find in the

[913] Pauli to Jaffé, 28 Oct. 1953 [1664], *PLC IV/2*.

[914] Pauli, 'Ideas of the Unconscious', *WPP*, 161, footnote 22.

[915] C.G. Jung, 'The Flying Saucers - a Modern Myth of Things Seen in the Skies' (1958), *C.W.*10, §636.

animal world. We find the 'evocative effect' chiefly in the human sphere in relation to the transformative forms, which are created or produced with the aid of a superior *gestalt* function. One should therefore be very cautious in equating the structures which underlie the instinctive behaviour of animals with the archetypal structures which underlie human intellectual life.[916] First and foremost there is a need for more research into the differences. But what can definitely be said, according to Portmann, is that our 'Being' as a whole, *knows* more than our consciousness.[917] Portmann stresses that he is aware of the danger of stretching a concept such as *knowing*. It is nevertheless preferable as a hypothesis to those lines of biological research which look upon the living being as an object. By putting 'knowledge' in focus the living being is instead placed in the centre as an active subject.

Jung returns to the idea that living organisms have been equipped with an innate 'knowing', ideas that he had already found in Leibniz and Hans Driesch.[918]

> Final causes, twist them how we will, postulate a *foreknowledge of some kind*. It is certainly not a knowledge that could be connected with the ego, and hence not a conscious knowledge as we know it, but rather a self-subsistent 'unconscious' knowledge which I would prefer to call 'absolute knowledge'. It is not cognition but, as Leibniz so excellently calls it, a 'perceiving' which consists – or to be more cautious, seems to consist – of images, of subjectless 'simulacra'.[919]

The central issue here is the transfer of information in ways as yet unknown to us. Hitherto information has been thought of as something that can only be transferred from consciousness to consciousness. Now it becomes necessary to work with the idea of information being transferred by other means, for example by the psychoid or psychophysical basis of consciousness, which is common to the whole human race. Jung quotes the zoologist A.C. Hardy, who has put forward a similar idea:

> The zoologist A.C. Hardy reaches similar conclusions. 'Perhaps our ideas on evolution may be altered if something akin to telepathy – unconscious no doubt – were found to be a factor in moulding the patterns of behaviour among members

[916] Portmann makes a distinction here between the instinct and the archetype which Jung does not make. The instinct is defined as something which is triggered solely by an external gestalt and the archetype as something which is 'created' or 'evoked' by man's higher functions. Jung does not make such a distinction, but sees only the effect that both instinct and archetype have on man – seeing them as superior powers which regulate, modify and motivate the contents and actions of consciousness. (See Jung, 'On the Nature of the Psyche', *C.W.*8, §404.)

[917] Adolf Portmann, 'Die Bedeutung der Bilder in der lebendigen Energieumwandlung', *Eranos-Jahrbuch* 1951 (Zürich, 1952), 352.

[918] Jung, 'Synchronicity: An Acausal Connecting Principle', *C.W.*8, §931, 'On the Nature of the Psyche', *C.W.*8, §380.

[919] Idem, 'Synchronicity: An Acausal Connecting Principle', *C.W.*8, §931.

> of a species. If there was such a non-conscious group-behaviour plan, distributed between, and linking, the individuals of the race, we might find ourselves coming back to something like those ideas of subconscious racial memory of Samuel Butler, but on a group rather than an individual basis.'[920]

From the assumption of a transfer of information via the unconscious as defined by Jung it is not a great step to assume that exchange of information can take place on a level which lies beyond our division of the world into psyche and matter, organic and inorganic, and time and space. Pauli believed that serious research in physics, psychology, biology and parapsychology might be able to throw light on the question of information processing and transfer. He believed that Jung's archetype model and the concept of *absolute knowledge* could be a helpful perspective in this respect. The psychic factor might possibly be active as a basic component of biological evolution and manifest itself as a *purposeful holistic regulation of life phenomena*. He assumed that 'this holistic occurrence of meaningful coincidences points to a psychological factor in the biological evolution going hand in hand with it and appearing on a higher level as emotionality or excitement.'[921] The same ordering factor that expresses itself in purposeful biological structures in the external world appears as meaning and numinosity in the internal world.

> It seems to me that one has to come to a point where the damnation [Unheil] of 'pure' knowledge turns back into salvation [Heil] because one will be compelled *to take into account emotional factors in the contemplation of nature*. I presume that these will play a certain role in biology if one is no longer so naive as to resort to 'chance'. For *holistic regulation* and *psyche* are one and the same, only seen from without and within, and are at the same time the characteristic of *life*.[922]

Pauli hints at an evolutionary theory for a psychic factor in nature that has been present from the beginning in the building blocks of matter and life and that has evolved alongside and in interaction with them. This factor would correspond to Jung's concept of the objective psyche. An encounter with this information-intense, space-and-time-relative 'entity' produces a strong numinous effect. Taking this into consideration we would obtain a new kind of natural law which includes an *emotional component*. In this context Pauli was thinking in particular of the *decline* (fatigue) *effect* in ESP research, which indicates that emotional involvement plays a important part in achieving a significant result. Naturally he was also thinking of Jung's synchronicity concept, where the numinous experience – in cases such as telepathy, pre-

[920] Ibid., note 39.
[921] Pauli to von Franz, Oct. 1953 'Die Klavierstunde' [1667], *PLC IV/2*.
[922] Pauli to Fierz, 17 Oct. 1954,[1894], *PLC IV/2*.

cognitive dreams and so on – is linked to the relativization of time. Pauli saw this point as particularly relevant, because it is the *time aspect* that plays such an important role in the question of adaptation in the biological theory of evolution.[923]

But all this was still provisional exploration and musing. What pained him, however, was that so many biologists reacted strongly and dismissively when he tried to discuss this question. Evidently they had called him a *mystic*. This led Pauli to add an acid comment in a letter to Victor Weisskopf. People who are free in using the epithet mystic about others and who say that they themselves stand on the side of pure rationalism, often tend to be susceptible to superstition. This is also the case with the biologists' primitive *Tyche cult*, in other words their worship of the goddess of fortune and chance. Pauli went on to say: 'There is only a *narrow* path of truth which leads between Scylla's blue vapour of mysticism and Charybdis' sterile rationalism. The road is full of pitfalls and one can fall down on either side.'[924]

In the midst of this interest in biology and his search for a third kind of natural law came the discovery of the DNA. Pauli found it particularly interesting that the model of Watson and Crick revealed an archetypal quaternary structure, in other words one based on the number four.[925]

> I had heard about the Watson-Crick paper. The proposed structure of the DNA appeals indeed very much to the sense of mathematics with its pair of two complementary one-dimensional tapes and with its foundation on the 'holy four' of the Pythagoreans.[926]

The DNA molecule combines a mathematical quaternary structure with a visible gestalt – the double helix – and it is directly linked to the origin of life. Pauli found this particularly interesting as he had been searching for so long for a link between Jung's archetypes, the mathematical structure of physics and, in more recent times, the mysteries of biological life. From different directions Pauli and Jung had reached the central core of the meeting of psyche and physis – the mystery of *numbers*. Jung had approached numbers and their combinations as qualitative magnitudes and studied their symbolic

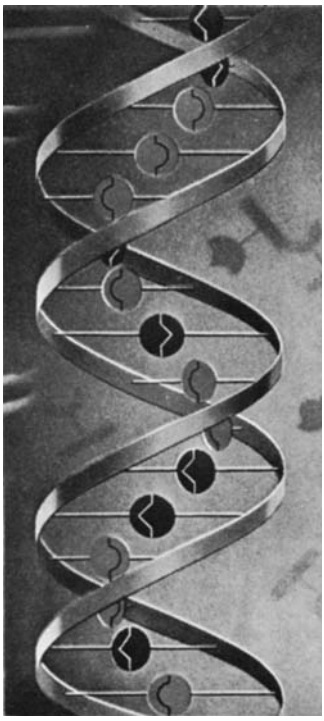
[923] For a fresh discussion of Pauli's ideas in relation to modern biological research see Müller-Herold, 'Vom Sinn im Zufall', 159.

[924] Pauli to Weisskopf, 8 Feb. 1954 [1716], *PLC IV/2*. See also Meyenn, 'Pauli's Belief in Exact Symmetries', 331.

[925] The discovery was published in *Nature* 171, 30 May 1953, Pauli starts to discuss it in February 1954.

[926] Pauli to Delbrück, 16 Feb. 1954 [1720], *PLC IV/2*, originally written in English. See also Pauli to Fierz, 9 Jun. 1954 [1827], *PLC IV/2*. 'And in the genes molecular structures based on quaternity [...] have now been demonstrated. ('Fons naturae animae que parens', as the Pythagoreans said).' I.e. quaternity is the source of nature and origin of the soul.

DNA which consists of the four substances thymine, adenine, cytosine and guanine



meaning. As a physicist Pauli had mathematics with him as an operational tool. Even while still with Sommerfeld, however, Pauli had come into contact with the Pythagorean legacy, in other words with the idea that man can contemplate the mathematical proportions of nature through the inherent sense of harmony and beauty of the soul. In his essay on *background physics* in 1948 Pauli had brought up the special character of mathematics; not only is it a quantitative tool, it also possesses *qualitative* characteristics. Number theory and topology are examples of this.[927] It had turned out to be impossible to explain mathematics as a purely tautological system, as certain mathematicians and philosophers had tried to do. Were mathematics to be tautological its freedom from contradiction ought to be possible to demonstrate from within mathematics itself, and Gödel had shown that it was not. According to Pauli, the freedom from contradiction in mathematics has therefore to be seen as a fact of nature.[928] Pauli was already convinced at an early date that the symbols of mathematics are real symbols accord-

[927] Pauli, 'Background Physics', *PJL*, 196.

[928] Idem, 'Ideas of the Unconscious', *WPP*, 160. Also Pauli to Weizsäcker, 21 Jun. 1954 [1837], *PLC IV/2*.

ing to Jung's definition – they reconcile opposites, not least because they combine the rational and the irrational. Just like the symbol, numbers both show a well-defined or visible form and also open into an inexhaustible, untranslatable side. Pauli was certain that people with true mathematical gifts always saw the signs and formulae of mathematics as true symbols, in other words both as rational tools and as creative units which offer deeper and as yet unknown possibilities of meaning.[929] The imaginary unit $i = \sqrt{-1}$ is a typical such symbol which gives many mathematical theorems a distinct and simple form.[930] According to Pauli everything suggests that mathematics is based on the *archetype of numbers*. If we can accept Jung's definition of the archetype as psychoid, this might explain why numbers can both be applied in the form of mathematical ideas in physics but also show a relationship with the psychic sphere as a whole, when they appear as quaternary and trinitarian structures.[931] In the non-visual and highly abstract mathematics used in quantum physics, the reconciling quality of numbers really becomes apparent. These symbols can reconcile the indestructibility of energy – in other words its timelessness – with its appearance in time and space.

> In this connection, it seems significant that according to quantum physics the indestructibility of energy on the one hand – which expresses its timeless existence – *and the appearance of energy in space and time* on the other hand *correspond to two contradictory (complementary) aspects of reality*. In fact, both are always present, but in individual cases the one or the other can be more pronounced. The 'non-visual' *mathematical functions* used by modern physics take on the role of symbols that unite opposites. (Such symbols are always of an abstract nature in psychology, too, whereas 'visual' in old physics would be analogous to 'concretistic' in psychology. Incidentally, for me the term 'visual' is largely a relative one and is simply a question of habit.)[932]

Jung had stated that symbols that reconcile opposites are in fact those that show the most abstract and paradox features. Male and female can easily be

[929] Pauli to Goldschmidt, 19 Feb. 1949, Goldschmidt, 24. Cf also the observations of Herman Weyl on the nature of mathematics: '›Mathematizing‹ may well be a creative activity of man, like music, the products of which not only in form but also in substance are conditioned by the decisions of history and therefore defy complete objective rationalization. [–––] it is surprising that a construct created by mind itself, the sequence of integers, the simplest and most diaphanous thing for the constructive mind, assumes a similar aspect of obscurity and deficiency when viewed from the axiomatic angle.' Weyl, 219–20.

[930] Pauli, 'Background Physics', *PJL*, 195.

[931] Pauli to Jung, 31 Mar. 1953 [60P], *PJL*, 108.

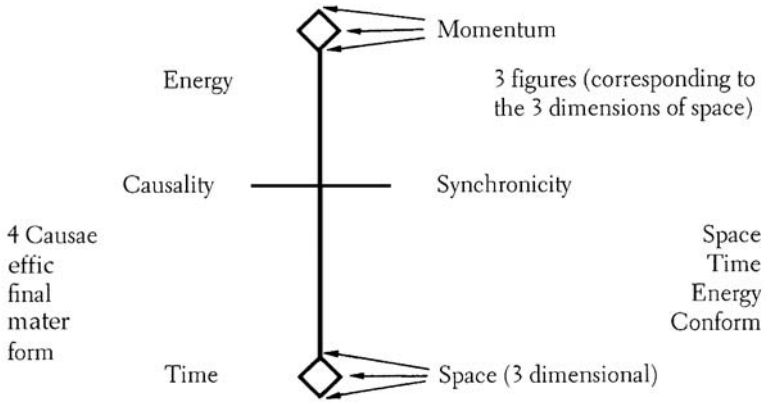
[932] Pauli, 'Background Physics',185, *PJL*. Translation altered by the author. In German the words *anschaulich* and *unanschaulich* are used. I prefer 'visual' to 'illustrative'. For a discussion of how to translate these terms see Arthur I. Miller, *Imagery in Scientific Thought* (Boston, 1987), 128–29 and footnote 222 above.

symbolized with a king and a queen, or a sun and a moon, whereas a symbol which reconciles opposites must resort to imaginary constructions such as the androgyne, the abstract symbol *lapis* or the well-known Chinese symbol *tai-chi*.

According to Pauli, mathematics is a genuine symbolic description of reality. The system of mathematical symbols is so subtle, well differentiated and general that it can also express mental processes in the finest detail, as Pauli considered was the case in his dreams. But as Pauli was the only one who could understand the mathematical-physical symbol language of his dreams, he realized that he had to try to translate them into a more comprehensible language, such as, for example, the language of analytical psychology. However, such a translation could never be all-inclusive.[933] When Pauli was looking for the essential theoretical foundation – or the common language – which can express the universal processes affecting both man and nature, he used the language of mathematics as a model. He therefore sought a concept which was on a higher level of abstraction and which could better express the generally valid.

The concept of *automorphism* came to him suddenly in a dream. Automorphism is defined as an isomorphic representation of a mathematical entity onto itself. The concept derives from mathematics and its author was the mathematician Henri Poincaré, who called mathematical functions with such characteristics 'Fuchsian functions'. Markus Fierz defined the concept as a system's depiction of itself which reveals the inner symmetries and wealth of relationships of a system.[934] Pauli used the concept of automorphism as identical with 'a self-reproducing form' and saw it as a superior concept which embraces both the concept of the archetype and the physical laws of nature. In this context he was particularly pleased with Jung's definition of the archetype as the *image of instinct in man*.[935] The archetype *in itself* would in a strict sense correspond to the elements in abstract algebra which 'lead to automorphism', while the different forms of one and the same archetype corresponded to automorphism itself. The concept of automorphism therefore belongs to the psychophysically neutral language for which Pauli was looking.[936] In relation to this he was interested in Jung's graphic representation,

[933] Pauli to Jung, 'Statements by the Psyche', 23 Oct. 1956 [69P], *PJL*.
[934] Fierz to Pauli, 17 Oct. 1951 [1292], *PLC IV/1*.
[935] Jung, 'Aion', *C.W. 9 II*, §278.
[936] One could compare the concept of automorphism with concepts like self-organization and self-similarity as used in modern chaos theory. (Gleick, 103.) Self-similarity is however rather different from what Pauli means by automorphism. Self-similarity is symmetry across the scale: the patterns look exactly similar in detail, however much one enlarges them. In automorphism there is no such visible recursion of patterns, here the forming factor is non-visual and the patterns appear in an



The worldview quaterrnio as automorphism[938]

published in *Aion*, where he constructs a chemistry-like formula illustrating the symbolic transformations of the conceptions concerning the Self.[937] This formula is precisely characterized by what Pauli means by 'automorphism' (four small squares of symbolic relationships building a bigger one representing a complete cycle) and it inspired Pauli to reconstruct the diagram they had agreed on in connection with Jung's essay on synchronicity.

Jung had asserted that what is specific about organic life in general and psychic life in particular is that it transforms the inorganic substrate into ever higher and more complex forms. How life does this we do not know, but according to Jung we have direct experience of such a synthetic process in the psyche.[939] The psyche follows its own laws. These cannot be reduced to the laws of nature known today, for the very reason that they contain a creative component which science does not take into account. Jung underlines that the archetypes combine determinism and indeterminism. The archetype is deterministic because it expresses a certain limited number of patterns of behaviour and apprehension. From the appearance of an archetypal occurrence it is possible – in part at least – to predict the probability of a certain psychic development. However archetypes are also indeterministic, because they constantly reproduce themselves in new and unexpected variations and forms. Jung equated the archetypes with nature: basically conservative, but constantly suspending its own limitations by acts of creation.[940]

infinite number of variations, like the hexagonal structure underlying every indivdual snowflake.

[937] Jung, 'Aion', *C.W. 9II*, §410.

[938] Pauli to Jung [55 P], 27 Feb. 1952, *PJL*.

[939] Jung, 'On the Nature of the Psyche', *C.W.*8, §375.

[940] Idem, 'The Structure of the Psyche', *C.W.*8, §339. This is quite reminiscent of the approach which

Pauli had noted the parallel development of concepts in quantum physics and depth psychology and saw this as very significant. It was to him evidence that both disciplines were approaching from their respective directions the common reality on which our psychic and physical experiences are based. The neutral language may describe processes which are active and observable in both the study of matter and the study of the psyche. The neutral language goes a step beyond the different languages which man has developed: the psychological, the physical, the theological, the metaphysical, the poetic and the everyday – but is nevertheless a part of all these languages, because it expresses universal processes.[941] Pauli saw it as nature's own language or at least the nearest we can get to nature's own language. Jung in turn had long asserted that the psyche is a piece of nature, whose products, such as dreams, visions, spontaneous fantasies and symbolic acts, can be studied on the same terms as a piece of physical nature. From his psychological viewpoint, however, Jung did not place such heavy emphasis on the parallel conceptual development in depth psychology and quantum physics. He saw this rather as a result of the fact that both disciplines had been confronted with the non-visual. Jung did not believe in an integration of psychology in a general expanded theoretical physics, as Pauli had proposed. Pauli on the other hand envisaged a general science which would include the gains of depth psychology. Jung's main argument against this was that the processes of the psyche are not measurable in the same way as physical processes. From Jung's point of view the two disciplines were incommensurable. However he believed in a closer investigation of their overlapping areas.

The borderland between physics and psychology lies in the mystery of numbers. To the extent that numbers are based on an archetype it must be assumed that they have substance, an individual form, a content and a relationship with other archetypes. Jung considered that numbers have the particular

is presented in more recent chaos theory: 'Rössler felt that these shapes embodied a self-organizing principle in the world. He would imagine something like a wind sock on an airfield, ›an open hose with a hole in the end, and the wind forces its way in,‹ he said. ›Then the wind is trapped. Against its will, energy is doing something productive, like the devil in medieval history. The principle is that nature does something against its own will and, by self-entanglement, produces beauty.‹' Gleick, 142. Or: 'A physicist thinking of ideas as regions with fuzzy boundaries, separate yet overlapping, pulling like magnets and yet letting go, would naturally turn to the image of a phase space with ›basins of attraction.‹ Such models seemed to have the right features: points of stability mixed with instability, and regions with changeable boundaries. Their fractal structure offered the kind of infinitely self-referential quality that seems so central to the mind's ability to bloom with ideas, decisions, emotions, and all the other artifacts of consciousness. [...]', ibid., 299.

[941] Pauli mentions an example of such a neutral process expressed in three different languages in a letter to Jung on 31 March 1953. The same process may be expressed in a physical language, in a theological/metaphysical language and in the language of analytical psychology. Pauli to Jung, 31 Mar. 1953 [60P], *PJL*.

character which can be designated psychoid – for they appear both inside and outside man. It is therefore impossible ever to decide whether numbers are devised or discovered. The same applies to the unresolved dilemma of the archetypes – whether they are innate or acquired. Were they nothing other than mental, they would of course be human inventions, not autonomous *existences*. The same must apply to natural numbers – they cannot be reduced *only* to human devices but must in some way correspond with the deeper essence of reality.[942] In the psyche numbers occur as qualitative, symbolic units capable of mythological statements. 1 = the One, absolute, the unconscious, God, the beginning; 2 = the division of the one, the pair, the relationship, the difference, the devil, the doubt; 3 = the rebirth of the one from the two, the son, the first masculine number; and so on.

In the inner world of man numbers appear as something holy or numinous. Externally, however, they exist in the form of amounts and tools of measurement. Jung compares them to the diamond, which is both used in industry as a technological device and admired for its exquisite beauty.[943] Numbers represent the most powerful instrument that man possesses, both for creating order out of chaos and also for discovering an existing, but as yet unknown, order. Presumably numbers are the most primordial ordering element in the human psyche. Among indigenous peoples one can see triads and tetrads as the commonest patterns of order. From a psychological point of view one might be able to define number as an *archetype of order which has become conscious*. The mandala structure which expresses the archetype of the Self – the highest and most charged archetype – is also a mathematical structure, it expresses and creates order.[944]

As stated earlier, Pauli had at the same time been inspired by Kepler's conception of the archetype. Here the archetypes are mathematical ideas and geometry is described as 'the archetype of the beauty of the universe'. Pauli could now link this with Jung's concept of the psychological archetype, which places the emphasis on the preliminary stages of the manifest idea. He was also attracted by the fact that Jung spoke of the *transgressivity* (boundary-crossing) of the archetypes. With this was meant that the archetypes, although they may be associated with or borne by causal processes, always go beyond their frame of reference.[945] Pauli associated the transgressivity of the archetypes with the mathematical concept of infinity.[946] Pauli thought that

[942] Jung to Pauli, 4 May 1953 [61J], *PJL*.
[943] Jung to Pauli, 24 Oct. 1953 [64J]; Jung to Pauli, 10 Oct. 1955 [67J], *PJL*.
[944] Jung, 'Synchronicity: An Acausal Connecting Principle', *C.W.*8, §870.
[945] Ibid., §964.
[946] Pauli to von Franz, 27 Oct. 1955 [2173], *PLC IV/3*.

the concept of the archetype ought in this way to be able to include original mathematical intuition, for example the idea of the infinite series of integers in arithmetic and the idea of the continuum in geometry. It would be very interesting, thought Pauli, to carry out a comparative study of the differences between those archetypal representations that form the basis of mathematics and more general archetypal ideas.[947]

While Pauli and Jung were discussing the archetypal nature of numbers and their autonomous dynamism, Jung had read Poincaré's *Science et Méthode*, and in particular the chapter '*L'invention mathématique*' (mathematical invention). It is very probable that Pauli had recommended it to him. Jung noticed at once the parallel between Poincaré's position and his own and was encouraged by what he read. Poincaré's questioning had proceeded in the same direction as his own, but not receiving any support from the psychology of his day Poincaré became bogged down at an early stage.[948] Poincaré had been one of Pauli's favourite authors in his youth. However it is difficult to know how much importance Pauli attached to Poincaré's philosophy. It seems rather that he had focused on Poincaré's works on mechanics.[949] Perhaps he was not particularly concerned with the chapter '*L'invention mathématique*' or maybe he took the contents for granted.[950] In a letter to Marie-Louise von Franz he deals with Poincaré's emphasis on intuition a little cursorily and says that it is not unusual for mathematicians to obtain their impulses direct from the unconscious.[951] As mentioned earlier Poincaré's philosophical viewpoint had certain points in common with that of Ernst Mach and William James. Apart from his contributions to mathematics, Poincaré is perhaps best known for his 'conventionalist' position, which, like the insights of Wittgenstein and Gödel, represents a break with the classical worldview. Poincaré stated that there is no way of showing which geometry is more 'true' than any other, we can choose the geometry that suits us best. The classical belief in eternally valid principles thus received a sharp knock and in keeping with the mood of the turn of the century it was emphasized that man constructs his own worldview by making choices. Along with this pragmatic attitude, we find in Poincaré a strong emphasis on the role of intuition for the mathematical dis-

[947] Pauli, 'Ideas of the Unconscious', 160. This is what Marie-Louise von Franz tried to do in the book *Number and Time*.

[948] Jung to Pauli, 10 Oct. 1955 [67J], *PJL*.

[949] Pauli to Dyson, 18 Feb. 1951 [1203], *PLC IV/1*.

[950] When leafing through Pauli's copy of this book I found many underlinings in other places, but none in this particular chapter.

[951] Pauli to von Franz, 22 Feb. 1951 [1205], *PLC IV/1*. 'I still see that you mention H. Poincaré. He was a favourite author of my youth. However the characteristic of experiencing intuition direct from the unconscious is surely one he shares with many other mathematicians.'

cipline. In contrast to analytical philosophy and logical positivism Poincaré emphasized the close connection of epistemology and psychology. Late in life he said 'Mr Russell will tell me no doubt that it is not a question of psychology, but of logic and epistemology; and I shall be led to answer that there is no logic and epistemology independent of psychology'.[952] He also pointed out the autonomously creative character in mathematical theorizing and the role of the subliminal ego, a term we know from James.

Briefly it may be said that Poincaré describes intuition as follows: After conscious exertion on a problem intuition suddenly breaks through with a fully fledged solution, usually when one is engaged in something else. This solution is accompanied by a feeling of absolute certainty. Poincaré considers that it is all due to the fact that the subliminal ego has taken over work on the problem, after consciousness has initiated it. It seems as if the subliminal is superior to consciousness because it works much faster and much more accurate. Poincaré gives examples from his own experience: For 14 days he had been working on a mathematical problem concerning what he later came to call Fuchsian functions. One evening, contrary to his usual habit, he drank black coffee and could not sleep. Then the ideas came to him in droves and seemed to be colliding with each other until two of them joined up, as it were, and created a stable combination. The following morning he had only to write down the results. A similar thing happened on a later occasion when he took time off from his mathematics to take part in a geological expedition. Just as he was getting on the bus, he had an idea, without any earlier reflection seeming to have paved the way for it. He did not verify the idea at that moment because he did not have time, but continued the conversation he had begun before getting on the bus. But, says Poincaré, '…I felt absolute certainty at once. When I got back to Caen I verified the result at my leisure to satisfy my conscience.'[953]

When Poincaré is trying to explain how ideas can suddenly break through into consciousness, he works with two hypotheses. To understand his reasoning better it is necessary to remember that at that time, if an unconscious or subliminal side of the personality was accepted at all, it was regarded as resembling a machine or a kind of automatism. Concerning the first hypothesis he says that the subliminal ego cannot in any way be inferior to the conscious ego. It cannot be merely an automaton, because it seems to have discernment, tact and taste. It seems to know how to make choices and it can

[952]Henri Poincaré, *Dernières pensées* (Paris, 1919), 139. Quoted in Miller, *Imagery in Scientific Thought*, 1.

[953]Henri Poincaré, *Science and Method* (1908), (New York, 1952), 52–53.

predict. But then Poincaré stops himself and bursts out. 'What am I saying? It can divine *better* than the conscious ego, since it succeeds where the latter fails. In a word, is not the subliminal ego *superior* to the conscious ego? The importance of this question will be readily understood.'[954]

Poincaré would himself hate to accept an affirmative answer to this question and therefore tests a second hypothesis. To escape the possibility that the subliminal might be an organ superior to consciousness, he puts forward the following proposition: combinations of ideas are formed as a result of the automatism of the subliminal ego, but only the interesting ones break through into the sphere of consciousness. But this is still very mystical. What is the reason for the fact that only a few of the thousands of products of our unconscious activity cross the threshold, whereas others remain below it? Is the selection determined by chance? According to Poincaré, this cannot be so. Among our sensory stimuli it is, for example, only the most intense ones that hold our attention. There cannot be an infinite number of combinations of phenomena, of which some satisfy the requirements and therefore come up to the surface. It is more probable that the process is started by intensive work on a particular question, which in turn mobilizes and defines the number of possible combinations and satisfactory solutions. The question why, despite this, only certain combinations cross the threshold and immediately attract our attention was answered by Poincaré as follows: it seems as though the only unconscious phenomena that are inclined to become conscious are those which, deep down, directly or indirectly affect our emotional sensitivity. Poincaré pointed out that it may seem strange to link mathematics and emotions, because mathematics appears primarily to appeal to the intellect. But that is to forget the importance of emotion while experiencing the beauty of mathematics, the harmony of numbers and the elegance of geometry. This aesthetic feeling is something that all mathematicians know and it is what may be called emotional sensitivity. The aesthetic feeling constitutes a fine strainer which allows the passage of the subliminal phenomena which possess such beauty, harmony and elegance that the mind can at the same time comprehend both the whole and the details.[955]

It was primarily later in life that Poincaré developed his ideas on the derivation and nature of mathematical ability. His ideas may be briefly summarized as follows: Man is born with two innate intuitions, mathematical induction and the mathematical continuum. In practice this means that all possible geometries are potentially innate in man. These may be discovered with brain

[954] Ibid., 57–58.
[955] Ibid., 58–60.

work. That Euclidean geometry so long reigned supreme was not, according to Poincaré, because it is mathematically more correct than other geometries but because it is most appropriate to our everyday experience. Poincaré thought that Euclidean geometry arose purely for reasons of survival. Our whole geometry is based in the last resort on the complex associations which man has acquired over the millennia in relation to the objects.[956] We thus find two components in Poincaré's philosophy: an innate primeval intuition and a complex of associations which man has acquired in the course of history and with which each individual is born again.

Jung of course felt at ease with these ideas. According to him the archetypal character of numbers is particularly evident in the *feeling* of *numinosity* or fascination that a mathematician may experience in relation to a mathematical theorem. The insight that mathematics has archetypal roots makes it impossible to ignore the relevance of feeling to the cognitive process.[957] Jung told Pauli that the numinous side of the archetype of numbers is expressed in their *autonomy*, which makes them capable of making their *own, creative statements*.

> 'In the Olympian host, Number eternally reigns' is a valuable acknowledgment from mathematicians as to the numinosity of number. Accordingly, there is sufficient justification for bestowing on number the characteristic of an archetype. Consequently, number also acquires the autonomy of the archetype ('dynamis' of number). For the mathematician, this feature of number is rather unwelcome and virtually unknown, since he uses it simply as a means to an end for counting and measuring, defining it as 1+1+1, etc. This is also the fate that befalls the archetype in (academic) psychology and is a clear effect of the prejudice against the unconscious in general. But given the indisputable numinosity of number, this resistance loses its validity, and one is forced to draw certain inevitable conclusions – namely, those same ones that psychology can no longer bypass: The autonomy of a psychic factor lies in the fact that thanks to its dynamic force, it is capable of making its own statements.[958]

The idea that numbers might be autonomous, creative entities arouses in many the same opposition as the idea that the unconscious, independent of our will, generates autonomous products by which we are affected. It is not unusual for a theoretician to experience an enormous fascination with mathematical and physical formulae – the theories develop a life of their own which seizes the researcher's imagination and ideas in such a manner that he is forced to occupy himself with them day and night. It could even

[956] Janet Folina, *Poincaré and the Philosophy of Mathematics* (Basingstoke, 1992), 132–138; Miller, *Imagery in Scientific Thought*, 25.

[957] Pauli to von Franz, 18 Apr. 1951 [1227], *PLC IV/1*.

[958] Jung to Pauli, 10 Oct. 1955 [67J], *PJL*.

be said that it is not the researcher who works with the theory – but the theory which works in the researcher, whether he likes it or not. One may be driven by this to the verge of exhaustion without the work necessarily leading to an important discovery. More often than not, all that is achieved is an overflowing waste paper basket and a feeling of dejection. Great discoveries represent exceptions in the life of the researcher, and even then they do not always bring unclouded happiness. What is this *fascination* that constantly drives man to devote all his powers to trying to solve an insoluble or perhaps even absurd problem?[959] Pauli was becoming more and more attentive to the role of emotion in the process of perception and cognition. Feeling goes as deep as thought, Pauli argued, '*amo, ergo sum*' is as justified as '*cogito, ergo sum*'.[960]

[959] Markus Fierz, 'Die Bedeutung der Jungschen Psychologie für die exakten Wissenschaften' (1975), *Naturwissenschaft und Geschichte*, 137–38.
[960] Pauli to Goldschmidt, 19 Feb. 1949, Goldschmidt, 24.

Broken Symmetries, the Chinese Revolution and the World Formula

We have seen how ideas of symmetry permeated Pauli's thinking, and also how his view of symmetry changed over the years. From a static 'taoist' worldview, characterized by an eternal cosmic order, he moved to a more dynamic, evolutionary belief, in which the unique moment of creation is included. In the 1950s Pauli became increasingly interested in the dynamic, 'rhythmic' aspect of existence. During his time in India in the autumn and winter of 1952 he was struck particularly by the prominent rhythm symbolism of Indian culture, which appears, for example, in conceptions of the periodic creation and decline of the ages of the world. This rhythm may be described as form in motion and is symbolized by, among other things, Shiva's dance. Pauli observed that it was the total absence of a rhythmic aspect in Christianity and Judaism that made it impossible for him to be touched by these religions. Quite simply, he said that they could not offer an adequate expression for his unconscious. In the Western tradition he had only been able to find the pre-Socratic Heraclitus and the Pythagoreans as representatives of such a rhythmic focus.[961]

According to Pauli this specific rhythm corresponds to *an inward perception of archetypal sequences*. Such a rhythm is for instance to be found in the stages of alchemy where various motifs succeed each other. Jung had observed that the healing process spontaneously expresses itself in such sequences. Pauli's interest in the importance of rhythm was intensified by the dancing female figure in his dreams – the exotic woman, the Chinese or 'dark' one. She symbolizes the psychic function in man that Jung called anima. To Pauli the Chinese woman represented the union of matter and psyche, in other words she stood in opposition to the scientific viewpoint, where psyche and matter are still totally separated. She personified psychophysical secrets, including sexuality and parapsychological phenomena. Therefore she also stood for a new integrated way of looking at things, where *feeling*, emotional interest, is given as much room as the intellect.[962]

Jung had described two basic principles of our understanding of reality: he called one *logos*, a masculine principle used in separation and analysis, and

[961] Pauli to von Franz, 16 Dec. 1952 [1498], *PLC IV/1*.
[962] Pauli to Fierz, 19 Jan. 1953 [1507], *PLC IV/2*.

the other *eros*, a principle with feminine characteristics which establishes connections and relations between parts.[963] It struck Pauli that his anima problem characterized not only him as an individual and scientist, but also Western science in general. Ever since antiquity, Western science has largely worked on a separating principle: spirit has been divorced from matter, body from soul, cause from effect, time from space. This has naturally been a necessary and fertile development, but like all progress it has taken place at the expense of something else. What has been sacrificed is the holistic view, something from which we particularly suffer in our time. While Pauli was pondering over these matters, Jung had just published his book *Answer to Job*.[964] This deals, among other things, with the dogma proclaimed by the Catholic church in 1950 on the Assumption of the Virgin Mary.[965] Jung saw this dogma as a step in the right direction as far as the equality of a feminine spiritual principle is concerned. However the dogma has not made her a goddess, but only a mediator between the masculine trinity and man. The elevation of Mary nevertheless symbolizes an equalizing of the opposing tensions between masculine and feminine in our Western Christian culture. In this context Jung also took the opportunity to criticize Protestantism, which has not joined in this development, but clung to its man's religion. Symbolically Jung interprets the dogma as a holy union between masculine and feminine which ought eventually to result in a new incarnation – in other words in a new conscious attitude. This new attitude will enable man to strive for wholeness instead of perfection, which has been the way of the masculine principle.[966]

With some reluctance Pauli had read the book, following which he wrote Jung a long letter. Pauli had construed Jung's book as in part an attempt to flirt with the theologians, which he did not like. Once he had read it he felt both inspired and disappointed. Pauli considered that the important thing about the dogma of the ascension of the Virgin Mary was that this dogma, this elevation of Mary's *body* to heaven, forebodes the raising of the *psychophysical problem* in science, too. The influence of Neoplatonism on both religion and science begins at last to decline. What used to be designated *privatio* is now recognized once more as something in its own right. The body, matter, the feminine, the dark, the irrational and acausal – which have been lumped together and banished from the Western worldview – can no longer be marginalized. The

[963] Jung, 'Mysterium Coniunctionis', *C.W.*14, §224 ff.

[964] C.G. Jung, *Antwort auf Hiob* (Zürich, 1952). See also idem, *C.W.*11, §553 ff.

[965] Pius XII's papal bull, which states that Mary in the heavenly bridal room has been united as bride with the Son and as Sophia with the godhead.

[966] Jung, 'Answer to Job', *C.W.*11, §748–753.

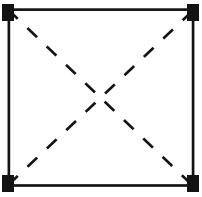
feminine in the form of body may now be included again, even if on sufferance and in a highly 'disinfected' form, elevated to heaven and the *pure* world of ideas.[967] To enable a true alliance of opposites to come about, matter, body and the feminine principle must be accepted in their own right, not merely in a bright, ethereal version. Instead of creating beautiful quaternities in heaven (Maria and the Trinity) a true symmetry would involve taking up the wisdom of the dark mother goddess and uniting it with masculine consciousness. What Western man needs is the wisdom of a Chthonian Sophia, who is both light and dark. Only such an earthly, subterranean wisdom can protect us against the products of the rational and masculine intellect, such as, for example, the atomic bomb. In physics as a discipline this would imply a closer association between physics, biology and parapsychology, in other words a descent from the abstract, causal and mathematical models, to the source and roots of *life*. Present-day, 'pure', one-sided, rational knowledge has become an unholy knowledge (*Unheilserkenntnis*). Sooner or later this must change, but it will only happen when one is once again forced to consider the emotional factors which are involved in the contemplation of nature. Only then can *Unheilserkenntnis* become *Heilserkenntnis* – the knowledge of salvation.[968] On the cultural plane this would mean a reduction of the polarity between patriarchy and matriarchy.

> Only the *chthonic wisdom of a Sophia*[1] (who is not only light but to the same degree dark) can compensate for the malignity acquired by the rational. [–––] what the unconscious, in compensation for the 'Zeitgeist' [–––] – of which the atomic bomb is also a part – demands of us, is a *mirror image of the Assumptio Mariae downwards, the reception of chthonic wisdom*[2] *from out of a mother's deep, dark womb into the upper masculine consciousness*. This could lead to a new equilibrium (whereas attaching it to quaternities in heaven leaves me cold).
>
> It seems probable to me that in this way the evolution which the unconscious will finally *compel*, will lead towards a new 'kingdom of the middle' with a *symmetrical* stance with regard to light and dark (Yang and Yin) and with a reduction of the stark opposition of patriarchy and matriarchy on cultural levels.
>
> [1]Prof. Jung calls this *also 'chthonic serpent's wisdom'* [see 'Aion']. One definition of chthonic might be: old, even atavistic, instincts of adaptation of life to the *physical* environment.
>
> [2]Expressed with me in the dark figure of the 'Chinese woman' (in contrast to the fair Madonna).[969]

Pauli felt that his Chinese woman symbolized this subterranean wisdom, nature's own knowledge. She represented a new line of research, encouraging

[967]Pauli to Jung, 27 Feb. 1953 [58P], *PJL*.
[968]Pauli to Fierz, 17 Oct. 1954,[1894], *PLC IV/2*.
[969]Pauli to von Franz, 12 Nov. 1953, [1672], *PLC IV/2*.

him in his dreams to give lectures to unknown people. Pauli interpreted this as meaning that he must somehow develop and present these cross-disciplinary ideas in a new forum. She also demanded a new approach to science, one which includes feeling, intuition and ethics.[970] In one dream she instructed him in the relationship between stability and dynamism by showing him the following picture:



Pauli's dream square

The square with the two diagonal lines represents the proportions of static and dynamic in the relationship of the four points to each other. Here one cannot achieve a static symmetry, as no figure can consist of four points and six *equally long* lines. A *dance* therefore takes place and the reconciliation of opposites (*Coniunctio*) implies changes of position or rhythmic turns. The three, which is latent in the square (two large and four small triangles), has to express itself in a *dynamic*. Pauli linked this symbolism with the concept of *automorphism*.[971] The dynamic symmetry is *self-organizing*, *self-reproducing*, and contains an intrinsic creative element.[972] Although Pauli's symmetrical thinking became increasingly dynamic, it was still very important to him that the dynamic symmetry displayed an exact mirror-like character. He was therefore attracted by Jung's thesis of *unus mundus*, where spirit and matter are complementary and reflect each other.[973] Jung had borrowed the concept of *unus mundus* from the late-sixteenth century Paracelsian physician Gerhard Dorn. Dorn saw the goal of alchemy as self-knowledge, which he also identified with knowledge of God. His originality lay in the fact that he saw as the aim a union of *body and soul*. *Unis mentalis*, mental unity, consisting of soul and spirit, would ultimately be united with the body. Dorn called this third union *unus mundus – one* world. This world is the Platonic primeval world that is also the future of the eternal world.[974] A true unity of opposites

[970] Pauli to Jung, 27 Feb. 1953 [58P], *PJL*.
[971] Pauli to von Franz, 12 Nov. 1953, [1672], *PLC IV/2*.
[972] Cf von Franz, *Number and Time*, 108.
[973] Jung, 'Mysterium Coniunctionis', *C.W.*14, §722.
[974] Jung to Pauli, 24 Oct. 1953 [64J], *PJL*.

where nothing is left out. For such a symmetrical union of opposites to be achievable, according to Jung, an elevation of the feminine principle was required – and on this Pauli could only agree.

> However I am, like Jung, of the opinion that the production of balance between the spirit and physical matter necessitates an *elevation of the feminine principle* or symbol and that this at the same time has to correct the one-sidedness of a purely patriarchal age. *This seems to be the mood of our time* (of which it may perhaps also be said that it has no chivalry).
>
> Insofar as science is a product of masculine consciousness, the 'eternal feminine' in terms of natural philosophy means the *consciousness-transcending unity* beyond the opposing pair. [–––]. Classical science from Galileo-Kepler-Newton right down to Einstein stands on the other hand for the trinitarian-patriarchal view. Only modern physics has again recognized that in this world actual phenomena of necessity form and remain complementary opposing pairs and that they at the same time allow the observer freedom. It has not yet been officially admitted that the psychic state of an involved observer may also have an influence on the natural process.
>
> I should like to attempt here to make a comparison with the ancient Chinese way of thinking (communicated to me by *R. Wilhelm*), in order to express what I cannot yet grasp in exact concepts: the two signs of the I Ching, Yang (male) and Yin (female), originally signify a mountain in the sun (south side) and a mountain in the shade (north side). We must learn to realize in our occidental manner and with the aid of *our* mathematics (which the ancient Chinese did not know) that there is only *one* X (*one* 'mountain', *one* 'content', *one* 'real', *one* 'essence', or whatever one may call the element of a still unknown and invisible reality) that according to the 'illumination' for us mortals i.e. according to how it appears in our human *consciousness* (*this* divides and distinguishes), appears either spiritual or material.[975]

On behalf of his profession Pauli felt guilt towards *the great mother*, *mater*, mother earth. She demands rehabilitation. He writes: 'Suddenly I had a remarkable *feeling* experience. The ›observation‹ of microphysics appeared to me to be a kind of *black mass* and I felt remorse. Remorse with regard to matter, which appeared to me to be a maltreated *living thing*. (Biological implication.) – The practice of this black ›mass of measuring‹ in the external world transforms only *its* condition, not that of the observer.'[976] Pauli saw here the alchemical position as the ideal and symmetrical one; the transmutation of matter is a process which *must* include the transformation of man – if he remains outside and only uses matter the whole thing will turn into a black mass.[977] Western man has created a razor-sharp demarcation between himself and matter. Matter is treated as an inanimate object which lies at his

[975] Pauli to Weizsäcker, 21 Jun. 1954, [1837], *PLC IV/2*.
[976] Pauli to Jaffé, Aug. 1954 [1865], *PLC IV/2*.
[977] Pauli to von Franz, 12 Nov. 1953, [1672], *PLC IV/2*.

disposal for exploitation. The attitude of the alchemist is more humble. He knows that every manipulation of matter reflects and has repercussions on his own condition. The transformation of matter stands in direct relation to his own transformation and redemption.

On 27 November 1954 Pauli had the following dream:

> I am in a room with the 'dark woman,' and experiments are being carried out in which 'reflections' appear. The other people in the room regard the reflections as 'real objects,' whereas the Dark Woman and I know that they are just 'mirror images.' This becomes a sort of secret between us. This secret fills us with apprehension. Afterward, the Dark Woman and I walk alone down a steep mountainside.[978]

In September 1954 Pauli had written an article summarizing the symmetrical features to be found in physics that was to appear in a Festschrift on the occasion of Bohr's seventieth birthday in 1955. This work was known as the CPT theorem. It summarizes the areas of symmetry which are acknowledged in physics:

- interchange of left and right = mirror-image effect (indicated by P, an abbreviation for *parity*)
- changing of the sign of the electrical charge (positive exchanged for negative = charge conjugation C for *charge*, and
- time reversal (with no change in the sign of the charge), indicated by T for *time*.[979]

In 1956 the parity principle (P) was questioned by researchers in connection with the observation of the decay of certain mesons. The parity principle states that if in the wave function which is associated with a certain particle the sign of the coordinates is changed, in other words, if x, y and z are replaced with -x, -y and -z, the wave function itself will change sign in some cases, but not in others. If the sign changes, the particle is said to have negative parity, in the opposite case it is said to have positive parity. However the fact that the sign of the coordinates changes means that one goes over from one system to another, which is the *mirror image* of the original system – in other words right and left are made to change places. Saying that parity is maintained is therefore the same as saying that nature does not distinguish between right and left, or that there is complete symmetry in space. An experiment that had been suggested by Chen Ning Yang and Tsung Dao Lee for the purpose of examining the

[978] Pauli to Jung, 5 Aug. 1957 [76P], *PJL*.

[979] Wolfgang Pauli, 'Exclusion Principle, Lorentz Group and Reflection of Space-Time and Charge' (1955), *Wolfgang Pauli: Das Gewissen der Physik*, 459 ff. Pauli to Jung, 5 Aug. 1957 [76P], *PJL*.

validity of the principle of the conservation of parity was conducted in 1956. Pauli was very sceptical about this experiment and did not believe that the parity principle would prove invalid. 'I do not believe however that the Lord God is a WEAK left-hander,' he wrote to Victor Weisskopf.[980] Nevertheless the experiment showed that parity, right-left symmetry, is not retained in weak interactions. When the decay of positrons was then examined in a similar manner, it was found that in weak interactions the symmetry which had been assumed earlier between particle and anti-particle did not apply either. The implication of this is that a particle is *not* identical with its mirror image, nor with its anti-particle. On the other hand it is identical with the mirror image of its anti-particle. The discovery of this earned Yang and Lee the 1957 Nobel Prize for physics and was called *the Chinese revolution*.

The results of the experiment reached Pauli on 21 January 1957 and they came as a severe shock to him. He said that he felt as if he had been deprived of an important symbol. When talking to Fierz he was for a time so upset that Fierz told him he had a 'mirror complex'. When he calmed down a little he was able to acknowledge that this was in fact true. He became interested in examining this mirror complex more closely, to find out what it might consist of. He wrote a long letter to Jung on the subject, where he tells a about further dreams with the mirror motif.[981] Pauli traced the events back to 1952, when he had once again begun to take an interest in the mirror motif in physics. He also recalled the aforementioned dream that followed on the completion of his article for Bohr's seventieth birthday. Pauli interpreted this dream as a conflict between the conventional view of the symmetries in physics, in other words including his own deeply rooted belief that nature must be symmetrical, and the actual situation. He believed that the dream shows that there is no symmetry between the objects and their reflections, and that it is necessary to realize the essential difference between object and reflection. This insight caused him deep dread, the same dread that he experienced when Yang and Lee presented their experimental results two years later. Now Pauli asked himself what psychological reasons there could be for this dread.

The first thing to strike Pauli in this context was that the mirror motif concerns the psychophysical problem that was so central to him. This motif permeates the hermetic and alchemic tradition: Macrocosm is reflected in microcosm, the spirit is reflected in matter. The motif also occurs in the gnostic myth of creation: *Nous* (the world spirit) catches sight of his reflection in

[980] Pauli to Weisskopf, 17 Jan. 1957 [2455], *PLC IV/4i*. See Meyenn, 'Pauli's Belief in Exact Symmetries', 351.

[981] Pauli to Jung, 5 Aug. 1957 [76P], *PJL*.

the water, falls in love with it and then falls into the bosom of matter. Pauli also thought that his interest in biology played a part. In March 1957 he received a book from Max Delbrück, which deals with the light-sensitive fungus *Phycomyces*. This work poses fundamental questions about the problematical relationship between physics and biology. Delbrück had in addition enclosed a card on which he enquired about Pauli's essay on Kepler, which of course also represents an attempt to link different disciplines. Then Pauli recalls earlier dreams in which he had to spend a long time in the constellation of *Perseus*. Shortly afterwards he reads an essay by Karl Kerenyi on Perseus as a symbol. Perseus overcomes the Medusa with the aid of a mirror, but Pauli also reads in this work that Perseus, who founded the city of Mycenae, gave the town its name because he found a fungus there, when he was searching for a spring (mykes = fungus). All these events seem to point to one and the same theme. This can only show one thing: An archetype is activated and constellates internal and external events around a particular motif. In brief: *synchronicity*.[982]

Pauli retells two other dreams in connection with his reading of Delbrück's work:[983]

> Dream of 12 March 1957
>
> A youngish, dark-haired man, enveloped in faint light, hands me the manuscript of a work. I shout at him: 'How dare you presume to ask me to read it? What do you think you are doing?' I wake up feeling very upset and irritated.

In his comment he says that the dream shows his 'conventional objections' to and *fears* of certain ideas. The following dream runs:

> Dream of 15 March 1957
>
> I am driving along in my car (n.b.: in real life I no longer have one), and I park it at a spot where parking seems to be permitted. There is a department store. Just as I am about to get out of the car, someone gets in on the passenger side; it is the young man who had handed me the manuscript in the dream three days earlier. He is now a policeman: 'Come with me!' he says to me brusquely, sits at the wheel, and drives off with me. (Sudden thought: the car driver Krishna.) He pulls up in front of a house, which seems to be a police station, and pushes me into the house. 'And now I suppose you'll be dragging me from one office to the next,' I say to him. 'Oh no,' he says. We come to a counter where an 'unfamiliar

[982] Pauli was so impressed by this example of synchronicity that he retold it in a taped conversation on 30 April 1957 to Hans Bender, professor at the *Institut für Grenzgebiete der Psychologie und Psychohygiene* [Institute for Fringe Areas of Psychology and Mental Health], in Freiburg-im-Breisgau Germany. See Appendix to letter [2586], *PLC IV/4i*.

[983] Pauli to Jung, 5 Aug. 1957 [76P], *PJL*.

> dark woman' sits. Turning to her, he says in the same brusque, militaristic voice as before: 'Director *Spiegler* [Reflector], please!' On hearing the word 'Spiegler,' I am so taken aback that I wake up. But I fall asleep again, and my dream continues: The situation has changed completely. Another man comes up to me; he bears a faint resemblance to C.G. Jung, and I take him to be a psychologist. At great length I explain to him the situation in physics – the one that has come about as a result of the recent experiments on the violation of the parity law – for I assume that he is not familiar with the situation. His replies are rather brief, and when I wake up I cannot remember them.

Pauli interprets the meaning of these dreams as connected with the attempt to bring together his interest in physics and psychology. The relationship between these two disciplines represents for him a mirror image. He is still suffering from a certain dissociation in this respect and Director Spiegler, who remains invisible in the background, tries to bring them together. This Director Spiegler, whose name means reflector or mirror, is obviously 'the archetype of archetypes' i.e. the *Self*. Pauli concludes that *one ought to be able to consider the archetype itself as an invisible reflector in the background, while the manifestations of the archetype may be regarded as reflections*. Pauli assumed that the underlying significance of the loss of symmetry in the parity experiment is that it is *necessary to look for deeper symmetries*, symmetries where one has to include the psychic aspect of nature. The deeper one goes into matter, the less one can discover symmetries in the parts. The question raised is:

> The question, 'how deep or how far must one go in order to achieve full symmetry?' ultimately seems to lead back to the problem – in your terminology – of the separation of the Self from the ego.[984]

At its deepest the symmetry problem concerns the relationship between part and whole and thus concerns the relationship and the boundary between the ego and *Self*. The whole problem is charged with the 'big' questions. In a letter to Fierz Pauli developed this idea further. He retells two gnostic notions. The first says when a person is born, a light goes out on the 'other side', and when he dies, it is lit again. The second story is that man has a reversed mirror image in the other world, which sleeps during his life and wakes when he dies. Pauli suspected that in his case the strong sense of shock at the loss of symmetry somehow involved the question of life, death and immortality. The loss of symmetry would mean that one is neither living nor dead. The constellation of the mirror archetype produced in him the primeval fear connected with the fear of death and confronting the *numinous*.[985]

[984] Ibid, 165.
[985] Pauli to Fierz, 15 Feb. 1957 [2517], *PLC IV/4i*.

In his reply to Pauli Jung suggested that *asymmetry* indicates *movement*. Asymmetry is connected with the dynamic elements of nature, it involves direction and process, unlike the stationary state implied by the equilibrium between opposites. One might see an equivalent to the CPT theorem in psychology, where reflection in space (right-left) might correspond to the division into conscious and unconscious. The reversal of time might in turn form a counterpart to the orientation of consciousness towards the future and the focus of the unconscious on the past. Jung finds it interesting that in physics the left side is emphasized, traditionally the direction of the unconscious. When consciousness finds itself in an insoluble dilemma the stronger position falls to the unconscious insofar as it potentially possesses the redeeming Third. The Third is the archetype that could unite or reconcile the opposites.

> This should mean that the mirror-image effects, which dazzle us, would be removed, and the opposites of the two Being aspects would be shorn of their power; this would be done by an 'asymmetrical' Third, which prefers one direction; namely – according to legend – the direction toward greater differentiation of consciousness, as opposed to the balance of conscious-unconscious. [–––] The fact that it is precisely the weak interactions that exhibit asymmetry forms an almost comic parallel to the fact that it is precisely the infinitesimal, psychological factors, overlooked by all, that shake the foundations of our world. [–––] You now know something that is a secret to everyone else – namely, that in the unconscious the Third is preparing itself and is already starting to neutralize the tension energy that comes from the opposites. What this means is the fading of the illusion that the opposites are really objects, and hence the self-evidence of symmetry.[986]

Jung concludes by thanking Pauli for his letter 'which has shed new light on many issues for me'. He is deeply impressed by the agreement of physical and psychological thought processes; it is truly an example of synchronicity. Thus ends the correspondence between Pauli and Jung.

The mirror archetype was to play yet another trick on Pauli. Pauli, who had always regarded Heisenberg's attempts to create a relativistic quantum field theory with some scepticism, became increasingly interested in his ideas in the autumn of 1957 and eventually gave in to his persistent efforts to persuade Pauli to collaborate with him. The background to this lies in the unexpected developments in physics, of which the loss of parity was one example. Pauli's scepticism concerning Heisenberg's theories was rooted in his aversion to the unverifiable Tamm-Dancoff approximation used by Heisenberg to calculate mass and coupling constants, but which he also used to calculate Sommerfeld's

[986] Jung to Pauli, Aug. 1957 [77J], *PJL*. Translation altered by the author.

fine structure constant (α = 1/137). Pauli described these calculations as based on 'the worst approximation methods ever invented in the history of physics.'[987]

The fact that Pauli began to collaborate with Heisenberg, despite his continued aversion to Heisenberg's approach, has to be seen against the background of the formulation of the CPT theorem in 1954, the experimental confirmation of Pauli's neutrino hypothesis of 1930 in June 1956, and Yang and Lee's parity experiment. In consequence of all this Pauli plunged back into research. He eventually succeeded in showing that for the neutrino weak interaction allows certain transformations which mix left and right neutrinos and anti-neutrinos to a certain definite recipe. This discovery was given the name *Pauli group*. On 5 November 1957, moreover, Gürsey had shown that this neutrino symmetry can also be used to describe the isospin symmetry of the nucleons. At the same time Heisenberg had succeeded in incorporating isospin in his spinor equation and therefore wanted to expand this in order also to include the Pauli group.

This formed the starting point of the last great collaboration between 'the giants' – the possibility of a synthesis of many disparate ideas in physics. As a background to this synthesis there was also the interest in the Lee model and the indefinite metric, which could be generalized by being combined with a double degenerated vacuum.[988] With this metric Pauli and Heisenberg hoped also to alleviate the problems in vacuum theory. Pauli saw the indefinite metric as a last attempt to preserve the possibility of a theoretical description of quantum physics with the aid of field operators. Underlying the whole set of problems was the unsolved problem, so central to Pauli, of the opposing pair of field and particle. In his closing words to the Relativity Congress in Berne in 1955, for example, he had said that he hoped that it might be possible to understand this opposing pair in the same way as the complementary pair of energy and position. The fine structure constant α = 1/137 plays an important part in this question. Pauli had asserted long before, in his Nobel address in Stockholm on 13 December 1946, that the last word in quantum physics will not be said until a theory has been developed whose result is the value of the fine-structure constant. Only in this way will it be possible to explain the structure of atomistic electricity.[989]

[987] Pauli to Landau, 11 Mar. 1958, see Charles Enz, 'Paulis Schaffen der letzten Lebensjahre', *Wolfgang Pauli: Das Gewissen der Physik*, 107.

[988] Charles Enz points out that this idea is of historic interest, as it represents the predecessor of the idea of spontaneous break of symmetry which is often used in modern physics. Ibid., 108.

[989] Wolfgang Pauli, 'Exclusion Principle and Quantum Mechanics', *WPP*, 181.

In February 1957 Pauli was still wary of Heisenberg's theories. He felt that he could clearly see that Heisenberg, too, was fascinated by the mirror archetype, as expressed in mathematical duality symmetry with the doubling and splitting motif.[990] At the end of 1957 Pauli suddenly became very animated and euphoric with regard to his work with Heisenberg. Heisenberg records that this was because he had found a field equation with an unusually high degree of symmetry, which he sent Pauli during the late autumn. Besides the time-space structure of relativity theory, it also contained the symmetry of proton-neutron.[991] Pauli's enthusiasm was heightened by the fact that he believed he could see certain central themes at the heart of their work together. He wished to summarize these with the words *division* and *reduction of symmetry*.

> Division and reduction of symmetry, this then is the kernel of the brute! The former is an ancient attribute of the devil (they tell me the original meaning of 'Zweifel' [doubt] was 'Zweiteilung' [dichotomy]). A bishop in a play by Bernard Shaw says: 'A fair play for the devil, please.' So let him join us for Christmas. If only the two divine contenders – Christ and the devil – could notice that they had grown so much more symmetrical! Please don't repeat this heresy to your children, but you can mention it to Baron von Weizsäcker.[992]

He also pointed out that the theory on which they were working was the most *quaternary* he had ever seen: the Pythagoreans would have been delighted with it:

> N.B. I have never yet seen such a *quaternary* system! The old Pythagoreans would have enjoyed themselves with their tetractys and their vow: 'See in them Pythagoras, who has delivered the tetractys to our souls *the fount and root of eternal nature*.'*
>
> *The tetractys could already be seen in Dirac. In this connection I would refer you to an essay by Schwinger in 'Annalen der Physik'. Unfortunately I have not yet had any time at all to read it, it is about the mesons and the hyperons and their interaction. According to what I have been told, a quaternary structure has put in there too. I assume this could fit in well with your model.[993]

Pauli was really affected and expressed himself in highly poetic terms. He saw a light at the end of the tunnel and believed in a real breakthrough:

> The picture keeps shifting all the time. Everything is in flux. Nothing for publication yet, but it's all bound to turn out magnificently. No one can tell just what marvels will appear. Wish me luck, I am learning to walk. [And then the quota-

[990] Pauli to Fierz, 15 Feb. 1957 [2517], *PLC IV/4i*.
[991] Heisenberg, *Physics and Beyond*, 233.
[992] Pauli to Heisenberg, 21 Dec. 1957 [2811], *PLC V/4i*, also quoted in Heisenberg, *Physics and Beyond*, 234; George Bernard Shaw, *Getting Married* (Leipzig, 1914), 153–54, 176.
[993] Pauli to Heisenberg, 4 Jan. 1958 [2823], *PLC IV/4i*.

> tion:] Reason begins again to speak, again the bloom of hope returns. The streams of life we fain would seek, ah, for life's source our spirit yearns. Greet the dawn of 1958 before sunrise… Enough for today. This is powerful stuff… The cat is out of the bag, and has shown its claws: division and symmetry reduction. I have gone out to meet it with my asymmetry – I gave it fair play – whereupon it made its quietus… A very happy New Year. Let us march toward it. It's a long way to Tipperary, it's a long way to go.[994]

Just before Pauli went to the USA at the start of 1958, where he came to discuss Heisenberg's theories and his own with colleagues, he wrote to Aniela Jaffé, telling her how he looked upon the collaboration between himself and Heisenberg. Although Heisenberg and Pauli were very different personalities, they could work so well together because *they were fascinated by the same archetype*. That Pauli set so much store by his work with Heisenberg was connected with his deep belief in this archetype: *quaternity and reflection* (mirroring). Pauli saw it as confirmation that these ancient symbols which Jung had explored in his psychology were now reflected in physics and mathematics. He went so far as to say that the theory of Heisenberg and himself constituted a *realization of the Self*. He tells Jaffé about a dream he had in November 1957 that had prepared him for this fertile cooperation with Heisenberg:

> *In our matrimonial bedroom I discover two children, one boy and one girl, both blond. They resemble each other a lot as if they just shortly before still were one and the same. They both tell me: 'We have been here for three days. We like it here, nobody has just noticed us yet.' Exalted I call my wife. She can't be far off, the children will soon have her wrapped around their fingers (in reality my wife is very yielding towards children) and they will from now on always stay here.*

Pauli was very excited for several days after this dream. He remembered that three days earlier he had had dinner with Heisenberg. This certainly influenced his decision to start cooperating with him. This is also the last recorded dream I have found written down by Pauli.[995]

The old, critical Pauli had not entirely disappeared, however. He entreated Heisenberg not to publish anything about their collaboration until it was complete. In February 1958 he read a paper to his colleagues and at the same time he began himself to feel a little less certain of the excellence of the theory. Most other physicists, such as Bohr, Lang, Lehmann, Zimmerman and Dyson, were apparently either unwilling to commit themselves or else they rejected it. In the meantime Heisenberg had been unable to restrain himself and had

[994] Pauli to Heisenberg, 28–29 Dec. 1957 [2811], *PLC IV/4i*, also quoted in Heisenberg, *Physics and Beyond*, 298.

[995] Pauli to Jaffé, 5 Jan. 1958 [2825], *PLC IV/4ii*.

informed the press of their work together. The rumour of this collaboration between the two giants spread like a bush fire and it was said that their unified field theory represented the final summary of physics and a new universal formula. In a letter to Heisenberg Pauli expressed his displeasure and no longer referred to their joint work, but to Heisenberg's own ideas. From his euphoric heights Pauli returned to earth with a bump. He felt as if he had fallen between two stools: the experts' (his fellow-physicists') and Heisenberg's. He had defended the theory against the experts while not entirely convinced of its outstanding merit himself. Now he found himself back on the ground and did not intend to be pushed in any direction by anyone.[996]

In March 1958 Pauli wrote to Jaffé that she should not believe the old refrain in the press about a universal formula. He found Heisenberg's appearances in the papers, and the interviews and pictures, in very bad taste. One should be glad if the work could bring the theory of elementary particles a little further along the way, but perhaps it would turn out like Hemingway's *The Old Man and the Sea* – the fisherman comes home with an empty net. Whereas he was consciously critical, however, the unconscious, at least, seemed to remain optimistic and he had positive dreams.[997] To deny the rumour of a universal formula, Pauli sent off one of his famous messages to his colleagues, showing that he had not lost his sense of humour.

By April 1958, Pauli had finally decided: he wrote to Heisenberg that he intended to withdraw from the project completely and that Heisenberg had free rein to publish the work in his own name if he wished. The biggest obstacle to Pauli was, as before, the Tamm-Dancoff approximation, but there were also other matters.[999] The manuscript *On the Isospin Group in the Theory of the Elementary Particles* was not published.[1000] Despite Pauli's humorous comment on the unsuccessful world formula, many of his colleagues felt that he was never really the same again after that. It was as if he had lost heart, and he appeared dejected. In his last letters to Fierz Pauli expressed a good deal of despondency over the way physics had become increasingly specialized and 'expert-oriented'.[1001] In a summing-up letter to Schrödinger Pauli wrote that future generations would remember him and his generation of physicists as those who failed to find a synthesis of the quantum theory and

[996] Pauli to Heisenberg, 1 Feb. 1958 [2849], *PLC IV/4ii*.

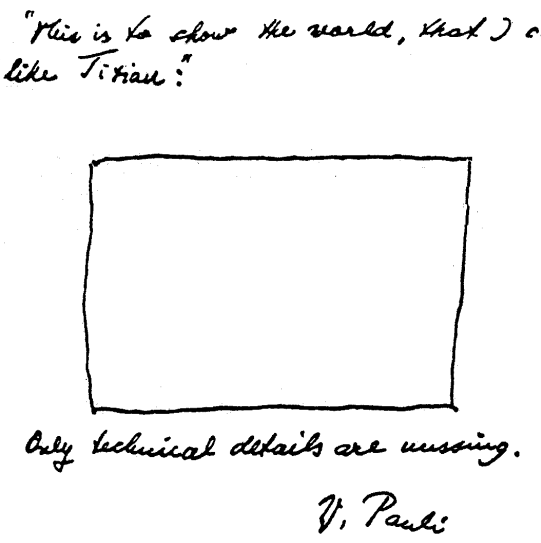
[997] Pauli to Jaffé, 27 Mar. 1958 [2825], *PLC IV/4ii*.

[998] The illustration appears in a letter to George Gamov, 1 Mar. 1958, and is also reproduced in George Gamov, *Thirty Years that Shook Physics* (New York, 1966), 162. Courtesy Pauli-archive, CERN.

[999] Pauli to Heisenberg, 7 Apr. 1958 [2959], *PLC IV/4ii*.

[1000] Today it is published in Blum, Dürr & Rechenberg (eds), *Werner Heisenberg. Collected Works. Series A: Original Scientific Papers* (Springer, 1989).

[1001] Pauli to Fierz, 9 Jul. 1958 [3029], *PLC IV/4ii*.



Pauli's Titian: This is to show the world that I can paint like Titian, only the details are missing… [998]

the theory of relativity, and who failed to solve such important problems as the fine-structure constant and the inherent energy of electrons.[1002] Schrödinger comforted him by saying that he believed posterity tends to remember what an epoch has achieved, rather than what it has failed in.[1003] On 5 December 1958 severe pain forced Pauli to break off his lecturing. He was admitted to hospital and when his last assistant, Charles Enz, visited him on 8 December Pauli wondered whether Enz had noticed the number of his room. It was 137, a figure which had engrossed Pauli all his life in the form of the fine-structure constant and which to him concealed a large part of the mystery of existence. Pauli died on 15 December.[1004] According to Aniela Jaffé, Pauli still wished to speak to one single person: C.G. Jung.[1005]

[1002] Pauli to Schrödinger, 9 Aug. 1957 [2688], *PLC IV/4i*.
[1003] Schrödinger to Pauli, 15 Aug. 1957 [2692], *PLC IV/4i*.
[1004] Enz, 'Paulis Schaffen der letzten Lebensjahre', 110. It is interesting to note that in the kabbalistic gematria the word Kabbalah forms the figure combination 137. Enz, 'Rationales und Irrationales', 30. See also Aleister Crowley, 'Book Three: Sepher Sephirot', *The Quabbalah of Aleister Crowley* (New York, 1973), 20.
[1005] Enz, *No Time to be Brief*, 534.

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Summary and Concluding Remarks

More and more the historians of science have shifted their focus from primarily working with the finally formulated, finished versions of scientific theories, to an interest in their formative history. This aspect of the history of science, which is known as the *context of discovery* or *science in the making*, sheds a different light on the advent of modern physics from that obtained from a history of science that starts with *science as an institution* (or the *context of justification)*. The perspective of *science in the making* focuses on the route the physicist was obliged to take in order to solve the problems that arose in consequence of the new empirical discoveries. For this kind of research handwritten material such as letters and manuscripts is the most valuable documentary source. Such material shows clearly the problems with which the physicist had to struggle during the birth of the new theory and gives a much more realistic picture of the scientific process than a history and theory of science which is reconstructed from the finished results. A history of science from a *science in the making* perspective shows how the physicist also wrestles with philosophical, epistemological, aesthetic and even emotional problems to reach a solution to scientific questions. Not much of this is visible in the finally formulated physical theory.

Besides relying on handwritten sources this approach also consults the popular and interdisciplinary production of the scientist or the scientific community, i.e. the need to fuse or connect the achievements of science with a 'bigger picture', with a philosophy, a message or a worldview. This is also an aspect of the science in the making, but is a very complex factor: it can be found as a formative force behind scientific achievement (i.e. philosophical taste or prejudice guides the scientific endeavour), but also as 'a revolutionary discovery', i.e. a sudden change of perspective that brings with it a need to 'understand' the world in a new way. It can also be a rhetorical, ideological device in order to give a scientific theory greater allure and influence, also outside the strict community of science. The study of *science in the making* therefore raises the question of the relation between purely scientific issues and philosophical, temperamental and aesthetic preferences of the working scientist as well as the influence of social and historical factors – like the 'spirit of the age' (*Zeitgeist*), power and competition – on the development of science.

As Pauli's correspondence is published and becomes available to the general public and to historians, we are seeing a number of different reactions. So far there has been a contrast in attitudes. Some find Pauli's interest in Jung quite incomprehensible and consider that it can only be seen as an example of the way in which even the most intelligent of people can be transformed into

idiots when they leave their own discipline.[1006] It is considered a 'paradox' that the rational scientist Pauli could have such a naive attitude to philosophy and psychology.[1007] Others consider that Pauli's interest in Jung and the perspective that it inspired is of the greatest importance to Western science and culture and that there is therefore an urgent need to publish Pauli's complete correspondence in a scientific edition, with comments by well-informed scientists. Hans Primas, professor of physical chemistry at ETH, thinks for example that a good knowledge of quantum mechanics, history of ideas and Jung's psychology is needed in order to approach the content of Pauli's correspondence.[1008] As this is a very rare combination, a number of conferences, symposia and publications have been arranged where psychologists, scientists, artists and others have made a serious approach to this problematic area.[1009] From the point of view of history of science, it has to be remembered that it is impossible to understand Pauli's later thinking, *even in the field of physics*, if one does not view it against the background of the psychology of Jung. This also applies to Pauli's attitude to theories which use 'hidden variables' and of course his final collaboration with Heisenberg on the unified field theory.[1010]

Was Pauli a disturbed man of two conflicting minds, a paradox of rational genius and muddled Jungian mysticism? It is in fact not strange at all for a successful scientist to have spiritual, philosophical and religious interests. Isaac Newton was interested in alchemy, René Descartes in dreams, Erwin Schrödinger in Hinduism, Pascual Jordan in parapsychology and so on.[1011] So what is considered so paradoxical in Pauli? My tentative answer would be that the unique thing about Pauli was a combination of several things:

1. Pauli did not keep his different interests in watertight compartments. It is not unusual for a physicist to believe in God or some other non-rational or spiritual entity, but most scientists keep their personal beliefs outside their professional domain. Pauli tried to find a bridge between his scientific knowledge and his spiritual or psychological experience.

2. The Jungian psychological perspective demanded a personal commitment from Pauli, a commitment to 'wholeness' and a unification of the different

[1006] Hans Jürgen Eysenck, 'Of Two Minds', *Nature* 361 (1993), 415.
[1007] This is stated by Bengt E Y Svensson, professor of theoretical physics in Lund, Sweden in an article discussing Charles Enz biography of Pauli *No Time to be Brief. Svenska Dagbladet*, 8 September 2003.
[1008] Hans Primas, 'Great Expectations', *Nature* 338 (1989), 306.
[1009] See for example *Der Pauli-Jung Dialog, Unus Mundus - Kosmos und Sympathie*, eds. Thomas Arzt, Maria Hippius-Gräfin Dürckheim & Roland Dollinger (Frankfurt, 1992).
[1010] Personal communication from Karl von Meyenn.
[1011] Erwin Schrödinger, *Geist und Materie* (Braunschweig 1959); C. Adam and P. Tannery, *Oeuvres de Descartes*, (Paris, 1908), vol. 10, 179 ff.

aspects of his life. To have a private philosophy is never experienced as paradoxical or threatening in scientific circles. But a psychological perspective, especially one that emphasizes the unconscious influences on our minds and on our thinking, will be felt awkward in the scientific community. The uneasy feeling comes from Pauli's blend of private experience (psychotherapy, dreams, emotions), personal standpoint (how different temperaments perceive facts differently) and exact science.

3. If we look at Pauli's differing interests not from the perspective of the traditional view of science as a purely rational pursuit, but rather as motivated by the deeper search for 'Truth', he may not seem so paradoxical. In B.J.T. Dobbs analysis of Newton's interest in alchemy, she argues that it was motivated by Newton's assumption of the *Unity of Truth*. All knowledge was ultimately a knowledge of God and it could be approached from every possible route: experimental discovery, revelation, reason, speculation, mathematics or the cryptic coded messages of the ancients in myth, prophecy or alchemy.[1012] The view of Newton as a Janus-faced man could very well be a modern optical illusion. Dobbs mentions that the assumption of the unity of Truth was common to his age. Ultimately Newton sought a grand unification of natural and divine principles by using a special methodology: accepting the possible validity of ancient knowledge he tested it against other facts and sources so that partial truths from different areas might coalesce into a larger truth.[1013] What is said here about Newton applies very well to Pauli. The problem is of course that the assumption of the unity of Truth, including a divine, spiritual or non-material truth, was not common to Pauli's age. It had been replaced by the claim of the unity of science.

My aim has been to present Pauli's interest in the psychology and worldview of C.G. Jung in a wider scientific and intellectual context. I have particularly wanted to show that it is impossible to reduce Pauli's interest to the mere fact that he experienced a personal crisis at the age of thirty. This naturally does not mean that this fact is unimportant. Had Pauli not experienced this crisis and come into contact with Jung's particular intellectual world, things would have looked different. Before Pauli could begin to regard the psychic process as *objective*, in other words as an *autonomous activity* of the soul, he needed of course to have come via the Jungian view of things to an acceptance of the

[1012] B.T.J. Dobbs, *The Janus Faces of Genius: The Role of Alchemy in Newton's Thought* (New York, 1991), 6 ff.
[1013] Ibid., 254 ff.

inner experiences as autonomous existences, capable of independent growth and development. Naturally Pauli's crisis was a *precondition* of his dialogue with Jung. It is clear that his starting point is in his personal experience of the analytical process and in his confrontation with the unconscious. Only later does he start to analyse Jung's ideas more closely, hence also the increase in conceptual criticism with time. But this still does not explain why Pauli developed and deepened certain aspects of Jung's perspectives and not others. I hope that my account has made it clear that Pauli seized on those aspects of Jung's thinking that were related to such philosophical questions as had interested him even before the two met. But it is misleading to try to reduce Pauli's philosophy to the few years during which he received Jungian analysis. His thinking is not identical with Jung's; he certainly obtained much inspiration there, but he was also critical of much, such as Jung's way of using the term *psyche*. Pauli placed, for example, greater emphasis on consciousness than Jung. To him it was important to limit the concepts of will and intent to consciousness. The unconscious on the other hand contains more 'knowledge' than consciousness. This 'knowledge' is presented in the form of compensatory and complementary images in, for example, visions and dreams. However the images must not be seen as objective communications from another world, but always as the result of a meeting, an *interaction* between conscious and unconscious. Conscious and unconscious are in a *symmetrical* relationship with each other. In particular Pauli wanted to emphasize that the epistemological situation, in other words the difficulty of observation, is the same in quantum physics as in depth psychology. All knowledge implies a *choice* of perspective and therefore also always a *sacrifice* of another kind of knowledge.

To Pauli, Jung's ideas represented an interesting starting point; they contained perspectives and viewpoints which were *worthy of exploration*. Pauli, who even before meeting Jung had been very interested in humanist perspectives, found in Jung an approach which could unite individual psychology and historical perspectives from the worlds of ideas, culture and science. With growing unease Pauli watched Jung's followers, who gathered around the 'master'. They lacked the scientific rigour which would have been necessary for a critical investigation of Jung's hypotheses. Instead Jung's ideas were turned into items of faith which formed the foundation of a profitable esoteric therapy factory. Pauli could not settle down in the protective circle of the psychological club, where nobody would have queried his interest in

Jung.[1014] Instead he continuously sought discussion partners among representatives of other disciplines, with whom he could develop and debate the perspectives Jung inspired. In addition to his fellow-physicists Niels Bohr, Markus Fierz, C.F. von Weizsäcker, Viktor Weisskopf, Max Delbrück, Pascual Jordan, Werner Heisenberg and others, he also had discussions with the art historian Erwin Panofsky, the cultural historian Erich von Kahler, the indologist Emil Abegg, the philosophers Franz Kröner and H.L. Goldschmidt, the philologist Ernst Howald and the Hellenist H.R. Schwyzer, and, in later years, the Judaist Gershom Scholem, professor of Judaic mysticism.[1015] In 1935 he met Elias Canetti at a reading from his works, and according to Canetti Pauli wished to guide him on a Jungian path.[1016]

Pauli's interest in philosophy, epistemology and psychology bears marked traces of the spirit of the turn of the century and the inter-war period which I have characterized as the *problematization of the position of man*. Many of his colleagues, not least Bohr himself, were interested in these boundary areas. Just like his mentor Ernst Mach, Pauli placed direct experience in the centre of his worldview and his outlook on science. This phenomenological position, which does not enquire about the ontological basis of the phenomenon but focuses on the psychophysical *experience*, pervaded the whole atmosphere of the period. From such a viewpoint Pauli was able without great difficulty to accept the experience of his own inner process as a part of the objective world of experience. This led him to identify his own scientific philosophy as one that emphasized a new view of the position of man in nature. On the same grounds his colleague Pascual Jordan felt that he could discern the possibility of a new scientific position which might be able to study all human experiences on equal terms, even such 'paranormal' experiences as had hitherto been marginalized as sources of error. We may also of course see the Jung – Pauli dialogue and the interest of Bohr and others in psychology as an example of the general psychologization of Western society and culture, a tendency that marks the whole of the last century.[1017]

By *not* excluding certain parts of the world of experience and *not* dividing existence into watertight compartments containing 'objective, physical, scien-

[1014] The psychological club was an intellectual and social forum for the group around C.G. Jung.

[1015] According to Weisskopf, Pauli had many discussions and considerable correspondence with Gershom Scholem. Unfortunately I have not had access to such letters and do not know whether they will be published. Weisskopf, 'Meine Assistentenzeit bei Pauli', 87.

[1016] Enz, *No Time to be Brief*, 289; E. Canetti, *Das Augenswpiel. Lebensgeschichte 1931–1937* (Hansen Verlag, Munich and Vienna, 1985).

[1017] See for example Joachim Radkau, *Das Zeitalter der Nervosität: Deutschland zwischen Bismarck und Hitler* (München, 1998); *Dreams 1900–2000: Science, Art and the Unconscious Mind*, ed. Lynn Gamwell (New York, 2000).

tific experience' on the one hand and 'subjective, psychic, religious and other experiences which we ought to keep quiet about' on the other, Pauli put himself in a situation which required an expanded world picture. Wittgenstein and Gödel were kindred spirits. Masters of rational thinking, they went to its limits and thus shattered the foundations of the classical worldview. They all came to the same conclusion: it is impossible to exclude the *irrational* from the worldview, in actual fact it forms a necessary point of reference in every system. Bohr, too, belonged to the group who asserted that the logically clear and precise does not lead to a true picture of reality. The truth requires a view which is directed towards the whole, which limits clarity. Truth dwells in the deeps, said Bohr. Reality is something 'over and above', said Wittgenstein. Pauli expressed it in the words: 'Every truth also contains something partly unknown, only suspected and therefore hidden.'[1018] Reality is *symbolic*.

Pauli sought a unified worldview and outlook on science which could unite the opposing pairs of psyche and matter, thought and feeling, specialist knowledge and holistic view – opposites which he found in the conflict between Kepler and Fludd. Above all he wanted to unite the knowledge of the psyche with that of the physical. Pauli saw a particularly important turning point in the history of science in the seventeenth century. In the late Classical period and during the Renaissance, matter had still been seen as living and animate. The vital force was called *anima mundi*, the world soul. This feminine principle was conceived as the connecting link between spirit and matter. Man's own soul stands in direct relation to this world soul and that is why man can understand nature. Thus man's soul is not separated from the innermost essence of nature – we are connected with the rest of the world.

In the seventeenth century, however, *anima mundi* was banished from the worldview. Descartes declared that matter is inanimate and controlled solely by the laws of mechanics. The expulsion of the world soul from nature laid the foundations of a mechanistic worldview and science. God became the clockmaker who started the machinery of the universe, but after that he had nothing more to do with the world. Everything could be explained on the basis of cause and effect, everything that exists is caused by something that has already existed. Time and space become absolute, unchanging and static categories which are not influenced by anything. The culmination of this development was reached when even the soul was declared a mechanistic system of neurological synapses. Not only was there no longer any connec-

[1018] Pauli to Goldschmidt, 19 Feb. 1949, Goldschmidt, 24.

tion between body and soul – the soul had ceased to exist. This historical development of science runs parallel with the increasing devaluation of the female and of the feminine principle and belongs to it psychologically.

What began to happen around the turn of the century must according to Pauli be interpreted as the return of the feminine principle. Einstein's theory of relativity showed that neither time nor space are absolute categories but that they are interwined. Man, the observer, immediately returns to the world of science when Einstein states that space has to be defined from the position of the observer in a movable system of reference. The universe can no longer be defined as an intrinsically dormant mechanistic system, but has to take into account the conditions under which reality is observed. This tendency was further strengthened by the advent of quantum physics: both Werner Heisenberg's uncertainty relation and Niels Bohr's complementary principle place the observer and the process of observation in the centre of the laws of physics and deal a sharp blow to the law of causality. Instead every observation is now seen as a unique *creative* act, where it is necessary to choose perspective on reality. It is in the meeting of subject and object that reality is created.

From Pauli's perspective this means the beginning of the return of the feminine principle to the Western worldview. *Eros* shows how things are interrelated, linked to each other. But anima is also linked with the deepest mysteries of existence – the rhythm of life and death and the creation of the unique. Pauli's dreams increasingly often contained a dancing woman with oriental features, whom he called the Chinese woman. This anima personified psychophysical mystery, in other words the connection between body and soul, matter and psyche. In this way she represented the direct opposite of the prevailing scientific viewpoint, where psyche and matter are still entirely separate. She embodied the psychophysical secrets, including sexuality and the 'parapsychological phenomena'. With her dance she stood for a dynamic asymmetrical principle, in contrast to the static and mechanical principle of classical science. She also represented a new unified form of contemplation where *feeling*, emotional interest, intuition and ethical questions receive as much room as the intellect in scientific work. In contrast to meaningless chance, she represented meaningful coincidences. Time, which in classical science constitutes only a mechanistic, linear progress of hands on a clock, is from the Chinese woman's perspective a succession of unique instants with a distinctive quality of their own, which unite the *now* of outer reality with that of inner reality.

Western science has created a sharp distinction between man and matter. Matter is treated as a dead object which is at man's disposal. Therefore Pauli felt

guilt on behalf of his science to *the great mother*, which demands restitution. Just like the old alchemists, Pauli considered that modern man has to realize that every manipulation of matter also has repercussions on man himself and reflects his own inner state. He believed that science could only develop in the right direction if it was realized that physical reality is connected with man's mental reality. The feminine perspective implies a focusing on the *totality* and searches for the unity which bridges the division of the world into exclusive opposing pairs. Classical physics from Galileo-Kepler-Newton to Einstein represents, to Pauli, a largely patriarchal thinking. Physics has not yet recognized that the mental state of the observer may be able to influence the observed natural process. The mental element, observation as a psychological process, is as yet an unconsidered fact in the self-understanding of science. Pauli felt that his Chinese woman symbolized a subterranean wisdom, nature's own intrinsic knowledge. Western man needs the wisdom of the dark mother goddess as a counterweight to the products of the masculine intellect. In physics as a discipline, this would imply an increased cross-scientific activity: one must climb down from the abstract, causal and mathematical models to the source and roots of *life*, in other words move nearer to biology, psychology and parapsychology.

As a physicist Pauli did not want to place the psyche in the centre, as Jung did; he sought a *neutral* point of view beyond the division of the world into psyche and matter, but at the same time something which could include both. He wanted to find an objective order in the cosmos and was not content with Jung's relativistic perception of objectivity. To Jung, every perception of truth and objectivity rested on the limitations of the human psyche. What is real is determined by who is making the observation. The perception of reality is temperamentally and culturally determined, objectivity always bearing the stamp of intersubjectivity, our conceptions always being moulded by the limits of the human psyche and projected onto the material world. Pauli certainly considered that Jung's perspective was of great value in the understanding of conflicts and differing perspectives in science, but he did not wish to stop at perspectivism. By seizing on certain intimations given by Jung himself, he wanted to take the concept of the archetype a stage further and link it to an objective, universal, cosmic order which unites psychic and physical reality. In this sense Pauli sought a *transcendental* reality, in other words a reality which *goes beyond* the opposing pairs, but which nevertheless is able to include them in a symmetrical manner within a greater whole. He did not seek a transcendence in the 'supersensory' sense. To him it was of the greatest importance for matter to be given as large a place in the worldview as the non-material.

On this point it was rather Pauli who tried to persuade Jung. Jung's later writings, in particular *The Spirit of Psychology* (later *On the Nature of the Psyche*), the essay on synchronicity and the work *Mysterium Coniunctionis*, bear traces of Pauli's influence. There Jung makes certain attempts to integrate his view of the psyche with hypotheses on how this is linked with physiological and physical reality. Pauli believed in the possibility of a *unified science* – an additional inheritance from his godfather Ernst Mach – which could unite psychology, physics and biology in a general science of life. Unlike the positivists, on the other hand, he did not see the unifying factor in the possibility of reducing these disciplines to sensory impressions or to general laws of physics – he sought instead a common deep structure for all disciplines.

One of the insights reached by both depth psychology and quantum physics is that one must reckon with at least two *levels* of reality. One is the naively perceived everyday world which is controlled by consciousness, a world of culturally specific categories and images. This is the world of classical physics and everyday perception. Then we have the non-visual – or unconscious – level, at which our classical laws and rational images no longer apply. To understand this deep level both physics and psychology have been compelled to work with symbols, probability and 'underlying structures'. It is at this deeper level that Pauli believes that *objective reality* is to be found. Pauli had hopes for a future research into these deep levels of the human psyche, i.e. scientific studies of cognitive functions, creativity and the process of dreaming that has not at all been realized by today's psychology. Instead depth psychology has become the big business of therapy that he feared. Scientific psychology on the other hand is still locked in its nineteenth-century mechanistic view of the mind, with its 'modern' metaphor of the computer.

Pauli states that the concept of reality has forever lost its innocence and must henceforth always include a problematization, an effort. It is no longer self-evident what is meant by reality. It is no longer possible to rest in a naive perception of reality, reality can only be approached by continuous *work*. Objectivity is no longer synonymous with the naively perceptible, concrete object which can be measured and weighed. Objectivity refers instead to general, abstract structures which are in specific relation to a concrete phenomenon. It is this relationship between the potential and the actual which Pauli calls *the reality of the symbol*. He associates it with the concept of *incarnation* – that reality is in a state of constant becoming. The deeper level of reality is still as yet unexplored, but the parallel conceptual development in quantum physics and Jung's depth psychology point to the direction in

which one ought to proceed. Pauli sums up what he can confidently say about this in the English summary of the article which he wrote in honour of Jung's eightieth birthday.

> In this article I was guided outside my special branch of science, by coincidences of the *sense* of the ideas occurring almost simultaneously in different sciences: 'correspondence', 'complementary pairs of opposites' and 'wholeness' appear independent both in physics as well as in the ideas of the unconscious. The 'unconscious' itself has a certain analogy to the 'field' in physics and both are shifted by an observational problem, outside the range of visualisability into the paradoxical. Although in physics one does not speak of 'archetypes' which reproduce themselves, but of 'statistical laws of nature with primary probabilities', both formulations meet in the tendency to amplify the older more narrow idea of 'causality (determinism)' to a more general form of connection in nature, toward which the psychophysical problem also points. This way of consideration leads me to the expectation, that the ideas on the unconscious will not be developed further in the narrow frame of their therapeutic applications, but that their junction with the general stream of the natural sciences of the phenomena of life will be decisive for them.[1019]

It is the occurrence of similar concepts and thought models in both physics and psychology that makes Pauli so certain that they rest on a foundation of shared structures. It ought to be possible to express these structures in a generally *neutral* language. As yet we know remarkably little about this depth structure, but one thing is certain – to understand it we must seek a *new type of natural law*, one which can include psychic reality as well as physical. This natural law must also encompass the irrational, in the sense of the creative and unique. In this way Pauli wants to unite the classical search for an objective worldview with the epistemological revolution implied by Kant and his successors. The irrational enters into science with the observer and the moment of observation, where every observation becomes to some extent an act of creation. By including the observer – not only as a measuring instrument but as a *person* – in the description of nature, we must also include psychology. The most evident psychological role in science is naturally that played by our intellectual apparatus: the possibility of processing, interpreting and understanding our observations. But man as a psychological being consists of much more than a recording intellect. Man consists of impulses, feelings, fears, fantasies and convictions which are based on archetypal models.

One of the ways in which such a psychological factor expresses itself is in the *fascination* of the practitioner of science with a subject, a fascination which is at best a commitment and at worst an obsession. If one is gripped by entirely different visions, a scientific discussion is difficult, if not impossible.

[1019] Pauli, 'Ideas of the Unconscious', *WPP*, 150.

An epistemological insight into the *religious* side of scientific work might be able to prepare the way for a more humble and fertile meeting of different schools and disciplines. The insight into the fact that science rests on irrational foundations, in other words that rational conceptualization and scientific theory rest on a preliminary stage of figurative and intuitive viewing, was developed by Pauli in his essay on background physics. It became important for Pauli to emphasize that one can never achieve a complete knowledge of the process of scientific conceptualization if one does not take this preliminary stage into account. For it is here that the creative side of scientific activity is based. Pauli divided up science into two distinct parts: on the one side the *discovery* of laws of nature and the *advent* of theories, on the other the *confirmation* or *application* of them. The greatest gains of science quite often take place in an 'unscientific' manner, via feelings, intuitions, impulses and sudden flashes of inspiration – even via dreams and visions. Developing these inspirations by hard work and testing into applicable and fertile instruments is of equal importance.

Poincaré is one of the few scientists who have described these two sides of scientific activity. He also gave prominence to the significance of the emotional element which accompanies a scientific discovery. The psychic factor that Pauli called the feeling of *complete certainty* is what Jung calls the a-ha experience. Jung tried to summarize this experience, together with other strong emotional feelings such as fascination, arousal, commitment and intense interest, in the concept of *numinosum*. Numinosum consists according to Jung of pure psychic energy. He imagined that psychic energy was generated, shaped and expressed in archetypal patterns. Pauli's attitude to Jung's energy concept has been difficult to establish. To Pauli, the law of the conservation of *physical* energy was one of the most important, if not the most important, of the laws of physics and could never be questioned. On the few occasions when he mentions Jung's psychological energy concept, he is inclined to be critical.[1020] But he seems nonetheless to have entirely accepted the idea that the archetypes are associated with *numinosum*, a force which expresses itself in everything from pure instinct to the most spiritual striving. At the same time Pauli was fully convinced that the archetypes *in themselves* could not be defined as purely psychic factors. It is quite evident that it was Pauli's pressure that led Jung to widen his concept of the archetype in a more non-platonic, non-visual and non-mentalist direction and resort to the concept *psychoid*, as a reference to the possibility that perhaps the archetypes are

[1020] Cf Pauli to von Franz, 14 Jul. 1951 [1265], *PLC IV/1*.

not of a solely psychic nature. A further step in this direction was taken with the idea of a potential, constellating archetype 'becoming' and 'emerging' at certain qualitative moments in life closely associated with a widening and evolution of consciousness.

Might it be possible that the archetypes also structure matter? Pauli appeared convinced of it. That this is so is suggested by the fact that it is apparently possible to understand matter on a basis of mathematics, a discipline which both Kepler and Poincaré saw as 'the archetype of the beauty of the world'. From this angle Pauli constructs an epistemological theory entirely of his own which we do not find in Jung: at a certain level of abstraction our internal images and the structures of the external objects come into congruence and *overlap*. When this happens man has an *a-ha* experience.

Towards the end of his life Pauli came increasingly to place *feeling* in the centre of his view of things. Feeling goes as deep as thought, claimed Pauli, *amo, ergo sum* is at least as well-founded as *cogito, ergo sum*.[1021] The strongest of all sensations is the experience of *numinosum*. Just as in the case of the archetypes, he did not wish to limit this phenomenon to purely psychic experience. In line with his other ideas, he believed that the deepest processes of the psyche must have an equivalent in a generally valid natural process or natural law. What is expressed on a psychic level in a turbulent *a-ha* experience and in the experience of *meaning* and *purpose* – in other words the experience of having gained insight into a wider context – was something that he wished to link with a purposeful *holistic regulation of life phenomena*. These holistic structuring factors lie beyond psyche and matter and they are relative to time, space and causality. They possess an organizing and synthesizing character and express themselves in unique, creative forms. When such forms and systems are observed in external nature, we use words like purposefulness to describe their occurrence. If on the other hand one meets these factors in one's personal life they are experienced as an intervention from a higher order, often rich in *meaning*.

Pauli understood his late ideas as speculative and hypothetical. It is also quite clear that these perspectives and outlooks had the character of questions rather than of answers. But if both psyche and matter form an expression of a common, objective, underlying order – then one may also imagine that changes in the underlying order have repercussions on the whole world of phenomena, both psychic and physical, possibly according to some kind of parity principle in the cosmos. One may then imagine that by penetrating the

[1021] Pauli to Goldschmidt, 19 Feb. 1949, Goldschmidt, 24.

foundations of matter one comes into contact with this deep level, and thereby also influences psychic reality. In the same way one would have an effect on matter by penetrating the deepest layer of the psyche. Pauli was at any rate convinced that psyche and matter reflect each other or as he speculates in his last letter to Jung, that the archetype is a 'kind of mirror which manifests itself as reflections' in psyche and matter. Concretely this implied that every individual, in particular every scientist, bears a great responsibility for his psychic attitude but also for what he does with matter.

In 1960 Jung wrote to Vaun Gillmor:

> It is most unfortunate that Pauli died so early, as he was a physicist who had the ear of his time, more so than a psychologist like myself. There is a chance, however, that the future may develop a better understanding of the psychology of the unconscious and its far-reaching problems, and through it even its medieval pre-stages may become fertile ground for the further growth of the common problems raised by nuclear physics and the psychology of the unconscious.[1022]

[1022] Jung to Vaun Gillmor, 3 Feb. 1960, *C.G. Jung Letters*, vol. 2, 535.

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