Context of Discovery and Scientific Creativity

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According to Reichenbach, every scientist is exposed to psychological, social, and cultural circumstances which play a role when he discovers new results.
The legitimacy of a result, however, can neither be justified nor rejected by such *contexts of discovery*.
For the rational reconstruction of a result, for its *context of justification*, mathematical and logical deductions are to be used.

Hans Reichenbach
1891–1953

出所 http://www.humnet.ucla.edu/humnet/phil/Lectures/Reich.htm

In my publications I did, of course, not entertain the reader with my aberrations, but only described the paved way to him along which he can now effortlessly reach the summit. *Hermann von Helmholtz (1903)*

We can say at least one thing with certainty about biography: the ideas and opinions expressed by our subject came from a single mind and are integrated to the extent that that person was able to integrate them in his own thoughts. ... Science is created by individuals, and however much it may be driven by forces from outside, these forces work through the scientist himself. Biography is the literary lens through which we can best view this process. ... ... Letters written under great emotional stress are the best grist for the biographer's mill, because they lead straight to the heart of the subject's personality and reveal the groundsprings from which his actions come.

Hankins 1979

In this spirit, biographical material about creative work was collected and interpreted by, e.g., Paulhan (1901), Wallas (1927), Hadamard (1954), Simonton (1988), Miller (2000).

A still neglected chapter in the history of science literature is the integration of psychological factors, which Stefan Zweig has demonstrated in his historical portraits. For a complete description of the forces shaping individuals and, hence, their scientific work, their **psychological conditionality** *would have to be included together with* **internal scientific constraints** *and* **social boundary conditions**. *Since in most cases access to the necessary source material is restricted by a screened private sphere, such an enterprise can only be carried out under exceptional circumstances.*

von Meyenn 1997

Such material exists, for instance, from scientists such as
Gauss, Helmholtz, Poincaré, Einstein, Dirac, Pauli, and others.

[For artistic creativity, many sources exist as well, not considered here.]

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- *Verification*: The insight needs to be reconstructed by a succession of rational arguments which can be communicated. "Conventional words or signs have to be sought for laboriously" (Einstein).

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Luo/Nicki, Haider, Verleger, Reverberi, ...: neural correlates

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- How is this stability established ?

Wolfgang Pauli
1900–1958

The process of understanding nature, as well as the blissful experience in this process, when a new insight becomes conscious, seems to be based on a correspondence, a kind of congruence, of inner images in the human psyche with external objects and their behavior.
At this point it seems most satisfactory to me to introduce the postulate of a cosmic order, eluding our direct access, which is distinct from the world of appearances. ... The relation between sensual perceptions and ideas would then follow from the fact that both the soul of the observer and the observed object are governed by the same objective order.

(Kepler Article, 1952)

出所 http://faraday.fc.up.pt/Faraday/Recursos/webfisica/imagens_html/pauli.jpg

mental domain
objects in consciousness

material domain
objects in physical systems

mental domain objects in consciousness	material domain objects in physical systems

collective unconscious $\Longleftrightarrow$ holistic quantum reality

unus mundus

archetypes

quote

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Jung: the key to synchronicity is the concept of meaning, "blind chance" is only a limiting case of negligible significance. remark

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- What about scientific insight without problem solving?
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- What about non-scientific insight and creative work?
  – e.g., Mozart

- F. Paulhan: Psychologie d'Invention. Alcan, Paris, 1901.
- G. Wallas: The Art of Thought. Cape, London, 1927.
- H. Reichenbach: Experience and Prediction. University of Chicago Press, 1938.
- W. Pauli: Der Einfluss archetypischer Vorstellungen auf die Bildung naturwissenschaftlicher Theorien bei Kepler. In Pauli & Jung, Naturerklärung und Psyche, Rascher, Zürich, 1952.
- J. Hadamard: The Psychology of Invention in the Mathematical Field. Dover, New York, 1954.
- D.K. Simonton: Scientific Genius. Cambridge UP, 1988.
- A.I. Miller: Insights of Genius. MIT Press, Cambridge, 2000.
- M. Öllinger and G. Knoblich: Psychological Research on Insight Problem Solving. In Atmanspacher & Primas, Recasting Reality, Springer, Berlin, 2008.

The ordering factors must be considered beyond the distinction of 'physical' and 'psychical' – as Plato's 'ideas' share the character of a notion with that of a 'natural force'. I am very much in favor of calling these ordering factors 'archetypes', but then it would be inadmissible to define them as contents of the psyche. Instead, the inner images are psychic manifestations of the archetypes, which, however, also would have to create, produce, cause everything in the material world that happens according to the laws of nature. The laws of the material world would thus refer to the physical manifestations of the archetypes. ... Each natural law should then have an inner correspondence and vice versa, even if this is not always immediately visible today.

Pauli to Fierz, 7 January 1948

return

Pauli on statistics (1952):

Synchronistic phenomena defy being captured by natural laws because they are not reproducible, i.e. unique, and smeared out by the statistics of large numbers. By contrast, "acausalities" in physics are precisely described by statistical laws (of large numbers). —
Wanted: a type of laws of nature that consists of a 'correction of chance fluctuations by meaningful oder purposeful coincidences of acausally connected events'.

Pauli on Darwinism and final causation (1954):

This model of evolution is an attempt to theoretically cling, according to the ideas of the second half of the 19th century, to the total elimination of any finality. As a consequence, this has in some way to be replaced by the introduction of chance.

return

As a relation between the mental and the material, meaning can be understood in terms of a reference relation resembling the concept of intentionality (à la Brentano) in the modern philosophy of mind.
In such a framework, "blind chance" would amount to a reference relation without a fixed referent, where the content of a mental representation may refer to anything.

Such a move would render the Jungian idea of synchronicity much less mysterious than it is usually regarded.
As a direct application to mind-brain issues, relations between mental states and neural states encode the meaning that subjects experience in those states.

return

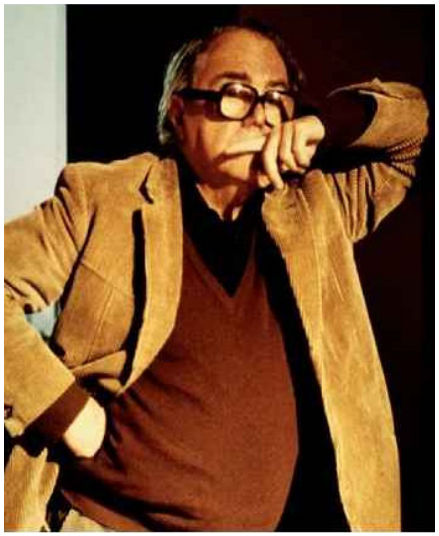
You may remember my earlier worries about a theorem which I then knew for more than two years, and which resisted all my efforts to find a sufficient proof. This distressed me even in the presence of all other results I found; and for four years there was rarely a week in which I didn't try to untangle this knot – particularly intensely more recently. But all breeding, all seeking was in vain, and sadly I had to put away my pen each time. Eventually, a few days ago, I succeeded – not due to my tedious efforts, but due to God's grace, I'd like to say. In a flash the riddle was solved; I would not be able to identify the link between what I knew before, what I used in my most recent attempts, and what led to the final success.

C. F. Gauss
1777–1855

Letter to Olbers, 1805

return

http://en.wikipedia.org/wiki/Carl_Friedrich_Gauss



Max Frisch
1911–1991

Time? It would be just a magic tool unfolding and making visible our essence by disentangling life, the omnipresence of all possibilities, into successive stages; only therefore it seems like a trans- formation to us, and therefore it urges us to assume that time, the successive, is not essential but apparent, an ancillary tool, an unwind that shows us in succession what actually is interleaved, a simultaneity which we cannot perceive as such as we cannot perceive the colors of light when its rays are not refracted and spectrally decomposed.

(Diaries 1946–1949, Suhrkamp 1997, p. 15)

return

出所 http://www.fkoester.de/biedermann/maxfrisch/seite1.html