Obituary

Paul A. Weiss (1898 – 1989)

... the mere reversal of our prior analytic dissection of the Universe by *putting the pieces together* again, whether in reality or just in our minds, *can yield no complete explanation of the behaviour of even the most elementary living system.*
Paul A. Weiss

Paul A. Weiss, non-reductionist. One of the true and original pioneers of general systems thinking and research, died in New York City on September 8, 1989. Another of the great and irreplaceable 'Systems-Viennese' has thus passed away before we have even started grasping the import of his insights and teachings.

He is survived by his wife, Maria, and a brother, Hans Georg, of Austria.

Paul Alfred Weiss was born in Vienna on March 21, 1898. To the United States he emigrated in 1931 (as a Sterling Fellow at Yale), becoming an American citizen in 1939. A biologist from Vienna who won the National Medal of Science in America, the nation's highest science award.

His work on cellular self-organization remains unsurpassed and still ahead of its time. Paul Weiss, virtually single-handedly, invented the complex concepts of self-organization, self-production (autopoiesis) and living systems. His understanding of the living organism as a system has remained untapped and is only inadequately approximated by the mechanistic, hierarchical reductionism of Anglo-Saxon thinkers.

Weiss established the experiments in which cells from different organs have been mixed randomly and their self-assembly into miniature copies of donor organs, without direction from a central source, was first established. Weiss proved that nerve cells replenished themselves to all parts of the body and established new surgical methods for the repair of peripheral nerve tissue. Weiss challenged the pre-scientific view that an embryo is organized by specific chemical compunds and established that an embryo's organization and growth is determined by physical and chemical environment surrounding newly multiplying cells. His 'triple interplay,' experience, experiments and logic, enhanced each other in the promotion of knowledge production.

Paul Weiss was a paradigm Central European: a soldier who served in the Austrian Army in World War I, studied law and engineering in Vienna, but earned a Ph.D. in biology in 1922 and conducted basic research for the Austrian Academy of Sciences. He taught at the University of Chicago for 21 years (1933–1954), became a professor at Rockefeller University (1954–1964), where he directed a new laboratory of developmental biology, specializing in wound healing, cancer research and the development and repair of the nervous system. After 1964 he remained a professor emeritus at Rockefeller University and served as a president of both the Society for Developmental Biology and the International Society for Cell Biology. His seminal contributions to general systems theory have remained unrecognized and unrewarded. Paul Alfred also wrote poetry, made sculptures and played the violin.

Dr. Weiss contributed more than 350 articles to professional and scientific journals and wrote 11 books, among them 'Principles of Development: A Text in Experimental Embryology' (1939), 'Dynamics and Development: Experiments and Inferences' (1968), and 'The Science of Life' (1973).

His most famous and seminal systems article appeared in 1925: *Tierisches Verhalten als 'Systemreaktion'. Die Orientierung der Ruhestellungen von Schmetterlingen (Vanessa) gegen Licht und Schwerkarft*, reprinted in English in *General Sys-*

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tems (Yearbook of the Society for General Systems Research), *4*, 1959, pp. 1–44. In responding to Bertalanffy's later (1945) emphasis on 'open systems,' he elegantly uncovered its artificiality and simplistic appeal by stating: 'I must, of course, consider *all* systems as 'open' – ideally and theoretically.' He also dismissed the anthropomorphic imagery of terms as 'organizers', 'regulators', 'control mechanisms' and the like, which mathematical particularists and failed engineers have had to invoke in order to fill the information gap between what one can learn from isolated elements and a valid description of group behavior. They simply bestowed upon the gene the faculty of spontaneity, the power of 'dictating', 'informing', 'regulating', 'controlling', etc. Q.E.D. The genes, highly organized in themselves, do not impart higher order upon an orderless milieu by ordainment of eager and unschooled observers. Genes themselves are a part and parcel of an ordered system in which they are enclosed and with the pattern dynamics of which they interact. How simple, how obvious, how Paul Weiss.

Weiss's best article, and in my opinion the best systems theory paper ever written, was *The living system: determinism stratified*, in A. Koestler and J.R. Smythies (Eds.), *Beyond reductionism*, Macmillan, New York, 1968, pp. 3–55.

'Life is process, not substance,' he wrote. 'A living system is no more adequately characterized by an inventory of its material constituents, such as molecules, than the life of a city is described by the list of names and numbers in a telephone book.' It reads like a commentary on the recent superefforts of scientific superpowers to create a superbook of 'Human Gene.' He was quite aware, long time before his time, that there is neither logical nor factual support for the supposition that organization can be explained in reference to gene interactions *alone*.

Paul Weiss coined the label 'molecular biology' in 1951 (simultaneously with W.T. Astbury), when he was chairman of the Division of Biology and Agriculture of the National Research Council. It caused him some pain later to realize that his 'molecular biology' has been taken over by reductionistic mathematicians, physicists and other upstarts of biology. Although there is no phenomenon in a living system that is *not* molecular, there is none that is *only* molecular either, he insisted.

The claim that the molecular gene string is the sovereign source of all order in an organic system he characterized as being based on blind faith and unqualified reductionistic preconceptions.

Paul Weiss, the scientist *par excellence*, expressed his frustrations with modern pseudosciences simply and clearly: 'To contend that genes can 'determine' the systemic wholeness of the organism, while at the same time being driven to invoking the systems analogy of brain action in order to endow gene action with the required integrating power, is logically such a circular argument that we can readily dismiss it from serious scientific consideration.'

What is a better way to remember the biologist?

Milan ZELENY