

Henry Margenau: Physicist-Philosopher

On April 30, 1991, the eminent physicist-philosopher Henry Margenau, co-founding editor of this journal, celebrated his 90th birthday. In commemoration of that auspicious event, *Foundations of Physics* will publish, beginning with the present number, a Festschrift series honoring this remarkable man and his lifetime of contributions to science and philosophy.

We met Henry Margenau in the mid-1960s, when already for decades he had been Professor of Physics and Natural Philosophy at Yale and was in fact only a few years from retirement. Yet the pace of his scholarly activities—writing, lecturing round the world, teaching, and supervising his doctoral candidates—was relentlessly energetic; and the multidisciplinary scope of those activities was incredibly broad. That breadth is aptly illustrated by the fact that we and our fellow graduate students were pursuing projects in a diversity of fields—mathematical physics, plasma theory, EPR paradox, intermolecular forces, spectral line broadening, quantum theory of measurement, quantum statistical properties of light—while simultaneously our mentor was exploring still other realms of natural philosophy.

Being students of Professor Margenau was a challenging endeavor, involving continual exposure to the daunting panorama of his interests and a great deal of quite independent research. Although there was no familial research “group” in the traditional sense, it was exhilarating to work in an atmosphere charged by such a broad range of research interests. His former students cherish the memories of their interactions and deeply appreciate that Henry Margenau was an extraordinary teacher and mentor who inspired us with a love of the subject and inculcated scholarly independence in us all.

In the course of a long, productive life, Professor Margenau has woven such a rich tapestry of accomplishments that we can hardly hope to provide a comprehensive biography in this brief essay. However, perhaps the following vignettes will convey, especially to younger readers of this journal who may be less familiar with his work, the amazing scope of his scientific and philosophical contributions.

Margenau was a pioneer in the application of quantum mechanics to the study of atoms and molecules. In the early 1930s, when quantum mechanics was new, he was among the first to explore quantum effects relating to intermolecular forces. He developed many aspects of that theory, including in particular the important realization that the Pauli exclusion principle should be imposed on the trial wave function. He was also among the first to obtain quantum corrections to the second virial coefficient of a gas. By 1939 he had become an acknowledged expert in the field of intermolecular forces, and his review article that year in *Reviews of Modern Physics* remains a classic. Also noteworthy from the 1930s are Margenau's fundamental contributions to the theory of collision (Stark or pressure) broadening of spectral lines. In fact, spectral line shapes and intermolecular forces remained lifelong interests throughout his career, and he continued to make contributions to these fields for some fifty years.

On topics ranging from philosophy to technical physics and chemistry, Margenau wrote many books, all characterized by such a clear and engaging style of writing as to make them 20th Century scientific classics that continue to exert a powerful influence on their readers. *The Mathematics of Physics and Chemistry* (1943), written with G. M. Murphy, served for many years as a standard text for physicists and chemists and was noted for its clarity and innovative methodology that smoothly integrated mathematics with subjects from physics and chemistry. Indeed we would venture to say that many students first truly learned their fundamental physics by reading Margenau and Murphy. And, in particular, the 100 or so pages on quantum mechanics was probably the place that a generation of students first came to understand and appreciate that subject. The style of Margenau and Murphy, in its time a dramatic departure from previous methods of presenting mathematical physics, proved to be a trendsetter; and to this day their mode of presentation is commonly employed by treatises in that discipline.

A few years earlier, Margenau had produced, in collaboration with R. B. Lindsay, another book that was also destined to influence and motivate generations of students—the classic volume *Foundations of Physics* (1936). In fact, for both of the current authors it was this book, read by us years before we studied under Professor Margenau, that inspired our interest in physics. It is a treatise remarkable for its profound explanations and insights of fundamental ideas, a survey of physics from a point of view that is both technical and philosophical. Its special power lies in exceptionally lucid analyses of what the fundamental equations of physics mean and of the underlying principles and ideas that went into developing them. It will undoubtedly remain one of the classic physics books of the century. Many years after the book had become so universally

respected, Margenau would amusingly reminisce about how, as a junior professor at Yale, he had to prepare that work somewhat clandestinely since the senior physics faculty frowned on such radical deviation from hard-science research and writing.

Professor Margenau's enthusiasm for philosophy of science has spanned virtually his entire life. His academic roots were actually in the humanities rather than the sciences, for his undergraduate days as an immigrant boy from Germany were spent preparing to become a teacher of Latin! An amazing metamorphosis occurred in graduate school, and he emerged from Yale in 1928 with a Ph.D. in physics.

Nevertheless, the philosophical proclivities of the young Henry Margenau proved irrepressible, and in the course of time the Yale physics department became well known, mainly through Margenau's prolific writing and lecturing, for its enlightened recognition and promotion of research in the philosophical foundations of physics. And, across campus, despite some initial skepticism from philosophers reluctant to admit a mere physicist to their exalted ranks, the Yale philosophy department eventually welcomed him as one of their own, so that for most of his Yale career he regularly offered courses in both departments.

Reading the abundant philosophical writings of Henry Margenau from the 1930s through the 1980s is a marvelous and inspiring intellectual adventure, encompassing everything from technical articles about quantum physics to general essays on epistemology, ethics, and religion. For decades Margenau has addressed in particular the fundamental issues of quantum mechanics, including among others the quantum theory of measurement. It was Margenau who, immediately after the original publication of the EPR paradox, demonstrated that the paradox disappears if the unreasonable assumption that wave-packet reduction is a necessary feature of measurement is abandoned. To his many articles concerning the relation in quantum mechanics between the measured object and the measuring instrument, Margenau brought a remarkable breadth of knowledge. For example, in a paper entitled "Exclusion Principle and Measurement Theory," he addressed a fundamental issue in the philosophy of science by using the theory of intermolecular forces!

Although the great volume of Margenau's philosophical work spans seven decades, it exhibits exceptional cohesiveness, the common thread being his distinctive, always expanding version of neo-Kantian idealism. Most readers would probably agree that his magnum opus is *The Nature of Physical Reality* (1950), which deals exhaustively with the problem of understanding that part of cognitive experience within which physics is constructed. Even now, over forty years after its initial publication, that book offers a refreshing alternative to the popular materialist-reductionist

interpretation of science that Margenau has always persuasively repudiated. In recent years his philosophical discourses have transcended the relatively narrow domain of physical reality to probe ultimate questions about the nature of man and the cosmos. *Einstein's Space and van Gogh's Sky* (1982), coauthored with psychologist L. LeShan, demonstrated the possibility of extending the methodology developed in previous writings about physical reality to construct alternative realities that might be more appropriate for extraphysical inquiries.

In some ways the most provocative of all Margenau's works is his latest monograph, cryptically entitled *The Miracle of Existence* (1984), which, despite its brevity, seeks to address metaphysical questions that have undoubtedly always lurked beneath the epistemological issues dealt with in previous works. Surprisingly, it emerges that Margenau, the renowned advocate and explicator of Occidental scientific method, finds a compelling ontology in the Oriental concept of Universal Mind. In a beautiful synthesis of the world's religions, he observes that "A great variety of names have described this Universal Mind, among them Tao, Logos, Brahman, Atman, the Absolute, Mana, Holy Ghost, Weltgeist, or simply God."⁽¹⁾ Finally, a rather charming metaphor at the end of the book lyrically captures the essence of Margenau's philosophy: "My conclusion is that [Kant's things in themselves] might be aspects of God's thought, of the Universal Mind. We have thus arrived at the beginning of our discourse, and our imagination sees two great figures, Kant and Bishop Berkeley, shaking hands."⁽²⁾

Indeed in our imaginations it is not difficult to see Henry Margenau shaking hands and chatting with the same duo.

Leon Cohen and James L. Park

REFERENCES

1. H. Margenau, *The Miracle of Existence* (Ox Bow Press, Woodbridge, Connecticut, 1984), p. 106.
2. *Ibid.*, p. 133.