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IN MEMORY OF PHILIPP FRANK

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For the last quarter century in Cambridge, and for about thirty years before that in Vienna and Prague, Philipp Frank was active as physicist, mathematician, philosopher of science, teacher of young and old—a champion of clarity, a searcher for unifying principles, a humanist as well as a scientist, and to a large circle of colleagues and students a treasured friend.

Philipp Frank was born in Vienna on March 20, 1884, the oldest of four children. In 1907 he obtained his degree of Doctor of Philosophy in physics from the University of Vienna as a student of Ludwig Boltzmann. Frank wrote later about this period: “. . . the domain of my most intensive interest was the philosophy of science. I used to associate with a group of students who assembled every Thursday night in one of the old Viennese coffee houses. We stayed until midnight and even later, discussing problems of science and philosophy. Our interest was spread widely over many fields, but we returned again and again to our central problem: How can we avoid the traditional ambiguity and obscurity of philosophy? How can we bring about the closest possible *rapprochement* between philosophy and science? By ‘science’ we did not mean ‘natural science’ only, but we included always social studies and the humanities.”

That passage illustrates what proved a lasting formula in Frank’s work: deepest involvement in central intellectual issues; construction of intellectual unities rather than merely iconoclastic revolt; and—equally important—pursuit of these discussions in a humane and deceptively informal setting rather than in a stuffy, *ex-cathedra* manner.

His combination of serious power and effortless style made Frank an effective and beloved teacher. Each essay, lecture, or conversation left his audience with new insights. That this should have been felt equally by Frank’s beginning students and long-term colleagues is the measure not only of a quality of mind but also of spirit; for there seemed to be in and around him a calm equilibrium that allowed problems to be seen with new clarity.

As a physicist, Frank was a creative contributor involved with fundamental problems of physics during an exciting period of its growth. His most widely known work was perhaps the two-volume collection, edited with his life-long friend Richard von Mises, *The Differential and Integral Equations of Mechanics and Physics*. A whole generation of physicists and applied mathematicians on three continents learned much of its mathematical physics from this source in which Frank's own original contributions figured prominently. But Frank's research papers, in this collection and elsewhere, ranged over a wide field of pure and applied mathematics and physics, sometimes in collaboration with distinguished mathematicians. Topics included variational calculus, Fourier series, function spaces, Hamiltonian geometrical optics, Schrödinger's wave mechanics, and relativity theory. On the last of these, in an early paper with Hermann Rothe, he introduced the elegant notion of deriving the Lorentz transformation equations from the fact that they form a group.

But his first and most lasting love was the philosophy of science. From the beginning Frank was intrigued by Poincaré's idea that many basic principles of science, such as the law of inertia and the principle of conservation of energy, are purely conventional. In 1907 Frank took the bold step of applying that idea to the law of causality too. The law says, in brief, that like states of the world are followed by like states. Whenever there is the threat of an exception to the law, Frank argued, we invoke hidden variables and deny, thereby, that the antecedent states of the world were alike after all. Causality is thus not a trait of the world, but only a point of policy in scientific theorizing. And it is even a point of policy from which quantum physicists have later felt it necessary to deviate.

Reminiscing, Frank later wrote: "While I was still a very young man, I published a philosophical paper [*Kausalgesetz und Erfahrung*, 1907] in which I made sweeping and amazing assertions. This paper attracted Einstein's attention, and he wrote to me that he liked it but found its claims exaggerated. From that time to this we have always been in scientific and personal contact."

In 1912, Einstein recommended Frank, then twenty-eight years old, to be his successor as Professor of Theoretical Physics at the University of Prague, a position Frank held until 1938. Frank's original paper on causality—which Lenin attacked in his book on positivistic philosophy and the sciences—was later elaborated and expanded into Frank's widely influential work on *The Law of Causality and Its Limitations* (1932). The friendship with Einstein deepened with the years, and in 1947 Frank published a definitive biography, *Einstein, His Life and Times*.

One use Frank made of his insight into the law of causality was in clarifying Driesch's doctrine of vitalism. Frank was able to represent this doctrine in a reasonably sympathetic light and then, gently, to reject it. Sympathetic examination and selective rejection was Frank's way. Thus he had no use for Nietzsche's metaphysics, but he valued Nietzsche's criticism of Kant. He had no use for Duhem's Thomism, but he appreciated Duhem's liberal view of the relation of theory to experience. He favored this approach over the less flexible empiricism which some of his associates had espoused in the group that during the 20's formed the so-called "Vienna Circle" of logical positivists and in the editorial board of its journal, *Erkenntnis*.

Thus, although Frank was a logical positivist, he was less doctrinaire than most of those who united under that banner. He was less formalistic in his approach than many positivists; he was more ambassadorial and conciliatory. On the other hand he could be quite firm and unequivocal in denying the claim that twentieth-century physics supported certain questionable views in social science, theology, biology, medicine and what he called the “occult sciences.” As one of his students put it, “I see in my present bi-focal memory of Professor Frank—not the intellectual ideal of the uncommitted intelligence which faces every fact with an unclouded eye—but the moral splendor of a man who could quite effectively, almost spectacularly, reject the sin and love the sinner.”

At Prague, as one of his students put it, Frank came to be a “fatherly figure who represented all that was best at the University. . . . He encouraged all of us students and he gave us the feeling of a wide-open intellectual window, open to things that happened in and out of physics, and open to things that happened outside the country as well. Philipp Frank saw to it that there was close contact with experimental physics at Fürth’s Institute, with pure mathematics, and with philosophy of science, presided over by Carnap.”

The breadth of interest which Frank exhibited in his work and fostered in his students made science a liberal discipline, and reflected a style of mind and of life. As he once remarked, he sought throughout his life to achieve a balanced outlook on man and nature; and physics for him not only provided reliable answers to special technical problems, but also raised and illuminated important questions concerning the nature, scope, and validity of human knowledge. Indeed, he believed that a stable perspective of life can best be achieved through the critical intellectual method of natural science.

He therefore saw it as a misfortune that science and philosophy are widely regarded as unrelated and incongruous pursuits. But it was also his conviction that this breach between a scientific and a humanistic orientation toward life—a breach that he thought to be of relatively recent origin—could be diminished, if not overcome, by an adequate philosophy of science. To be adequate, a philosophy of science in his view must also include certain socio-historical considerations—for example, analyses of circumstances (both internal and external to a science) under which changes in scientific doctrine and practice may occur; and of the grounds on which standards of scientific validity may differ for different times and in different subject-matters. Frank was not a purist in his conception of the philosophy of science, and he did not hesitate to “thicken” its content.

The general principle that governed his analyses of the logic of science is that ideas are best clarified by making explicit how they are used and what operative roles they play in various contexts. The meaning and validity of theoretical assumptions can be determined only if detailed consideration is given to the verifiable consequences which the assumptions entail. It also enabled him to call attention to certain misinterpretations of relativity theory and quantum mechanics, and to show how and why they have been fallaciously used in support of questionable doctrines. The titles of some of his books indicate these concerns. *The End of Mechanistic Physics* (1935); *Interpretations and Misinterpretations of Modern Phys-*

ics (1938); *Modern Science and its Philosophy* (1941, 1949); *Relativity, a Richer Truth* (1950); *Validation of Scientific Theories* (1957); and the textbook, *Philosophy of Science: The Link between Science and Philosophy* (1957).

In addition to producing numerous books and articles, Frank somehow always found time to act as organizer or chief participant in a number of activities, such as the International Encyclopedia of Unified Science, the Conferences on Science, Philosophy, and Religion, the Harvard Shop Club on the Science of Science (founded in 1940), the Institute for the Unity of Science, of which he was the moving spirit after his arrival at Harvard, and the Boston Colloquium for the Philosophy of Science. Typically, the phrase, "Unity of Science" connoted not a doctrinal position, but merely an interest in the interrelation of sciences and a commitment to the use of rational argument in discussing them. The meetings were sometimes quite casual, but always meaningful to a large circle of faculty members and students. For many years Frank was President of the Philosophy of Science Association and until his death he remained a member of its governing board.

Professor Frank came to the United States in the summer of 1938, to lecture on quantum theory and philosophical foundations of modern physics at some twenty universities. Shortly thereafter Czechoslovakia was invaded by the Germans. Like others who escaped the Nazis, Frank found he had to look for a new position in his middle fifties. In time, thanks to an initial financial assistance from the National Coordinating Committee and to the warm support of P. W. Bridgman and Harlow Shapley, a *modus vivendi* was arranged at Harvard. Frank was granted a modest half-time appointment as Lecturer on Physics and Mathematics; every other semester he had to teach elsewhere. At Harvard he taught thermodynamics, relativity, and two courses in the philosophy of science which quickly became a popular addition to the General Education Program. Their hallmark was an almost deceptive simplicity: he could explain so simply because he understood so clearly. Many of his students came to know the strength and limits of scientific inquiry and were charmed by Professor Frank's warm and witty approach to difficult subject matter, and his detailed recall of events and of illuminating anecdotes in the development of physical science and philosophy during a half century of active participation.

One of his students, now himself a productive physicist, recalled the course: "I think all of us who attended these classes were constantly awed, although this was never Professor Frank's intention, by his almost incredible erudition. He seemed to have read and digested the great philosophical, literary, and scientific works in an enormous variety of languages. He once told me that he had studied Arabic, as a young student, in order to be able to read the great texts in that language, and, fifty years later, he remembered it sharply enough to be able to write out, which I once saw him do in a discussion with an Iranian student, some of the passages in Arabic that had intrigued him. As a student I had the feeling that what he taught to us represented only the pure distillation of a vast reserve beneath."

When he and Professor Bridgman retired from Harvard, the American Academy of Arts and Sciences honored them by calling a special conference on the topic "Science and the Modern World View." Last year his friends, new and old, joined

in dedicating a *Festschrift* to Philipp Frank. A student read large parts of the book to him, and he seemed pleased. At the end, in his eighty-third year, he slipped into death quietly, as uncomplaining as he always had been. He was survived by his wife Hania, his constant, beloved companion throughout the good days and the sad ones. He died on July 21, 1966, ending a gentle, beneficent, and prolific life that gave the world far more than the world gave in return.