Rudolf Haag – Eighty Years

Rudolf Haag was born in 1922 in Tübingen, in that swabian part of Germany culturally tainted with a unique blend of elated poetical thrust and sharp practical sense: “Head in the clouds, feet firmly on the earth”. Rudolf’s family belonged to the cultivated middle-class. His father, Dr. Albert Haag was a high-school mathematics teacher (Gymnasialprofessor) with a philosophical turn of mind. Anna Haag, Rudolf’s mother, was an extraordinarily fresh and original woman. Her foresight sent Rudolf to visit England shortly before the outbreak of the war. Rudolf thus found himself trapped in England and spent the duration of the war as an inmate of a camp of interned German civilians in deep Manitoba, Canada.

Paradoxically, this period was crucial for Rudolf’s intellectual evolution. Prone to science as he was, he was induced as an autodidact to broaden his knowledge of differential and integral calculus, which he had acquired at high school. This self-initiation left him a connoisseur of astute calculations rather than of epsilontics. This Manitoba camp life-phase made Rudolf develop a philosophy of life where the value of man is largely independent of his social status.

After an adventurous return to Germany at the end of the war, Rudolf started his career as a scholar. Here are, in short, his various academic stations between his university enrollment in 1946 and his retirement in 1987:

- Studies of Physics at the Technische Hochschule of Stuttgart, concluded with the degree of “Diplom Physiker” in 1948.
- Doctoral studies at the Universität München under Fritz Bopp. This period in Munich leads to his “Promotion” (doctoral degree) in 1951 and his “Habilitation” (prerequisite for a university career in Germany) in 1954.

His teacher Bopp was an original mind interested in various deep subjects in a non-conventional way. But he shared the then prevailing callousness of German university
professors towards their assistants, who were not supposed to burden themselves with impediments like a wife and children. In 1948 Rudolf had married Kathé Füss. In the years that followed they had four children. Bopp delayed, for example, by two years the publication of a crucial article of Rudolf’s by failing to grant permission to use the address of the Munich institute. Nevertheless, Rudolf maintained a liking for Bopp, generously deeming that the lesson he owed him in “independence of mind” was worth his discipline.

The Munich period was interrupted between 1953 and 1954 by a stay in Copenhagen at the CERN theoretical study group led by Bohr – a period of intense personal progress. Rudolf began to develop original views on quantum field theory and, at the same time, had the occasion of forming important links with the young future elite of European theoretical physics. His subsequent stations were

- Max Planck Institut in Göttingen with Heisenberg, from 1956 to 1957.
- Princeton University, visiting professor from 1957 to 1959.
- Université de Marseille, guest-professor from 1959 to 1960.
- University of Illinois at Urbana, Professor of Physics from 1960 to 1966.
- Universität Hamburg, Professor of Physics from 1966 until his retirement.

Rudolf Haag’s decisive appearance on the scene of Quantum Field Theory was in 1955 with his visionary paper “On Quantum Field Theories”. At a time when the attitude of the practitioners of field theory was dictated by more or less heuristically developed computing prescriptions totally divorced from the contemporary mathematics, this paper offered a number of illuminating pieces of recognition, assigning a conceptual role to hitherto heuristic concepts whilst repudiating fraudulent pieces of gospel. The unviable “interaction representation” was demolished by Haag’s theorem implying the futility of trying to construct the free and the dressed vacuum in the same Hilbert space. The Fock space of non-interacting particles was assigned its correct role, that of describing incoming, respectively outgoing, scattering states connected by the S-matrix. Moreover, the need to distinguish between the strong and weak topologies in scattering theory was revealed for the first time. I vividly remember how the concepts were illuminated by reading this magnificent paper: I could feel the scales falling from my eyes.

The next discovery (shared, independently, with Hans Ekstein) was the elucidation of the multi-channel structure of scattering states – and the development of a collision theory based on the first principles of relativistic quantum field theory. This scattering landscape had the merit of putting Rudolf on the track of the principle of locality, hinge of the future approach to field theory through local algebras. At this point it was fortunate that Rudolf was given the opportunity to present his ideas in an early stage of decantation at the 1956 Lille meeting on field theory, which thus became the birthplace of algebraic field theory. The search for axioms for an algebraic approach was later pursued in a challenging paper with Schroer.

The next aspect calling for a doctrine was the question of what to do with the maze of representations, occurring as soon as the system is infinite, in contrast with the uniqueness of representations of the Heisenberg commutation relations. Here Rudolf had understood that the large distance behaviour would distinguish between representations, one of the insights gained by looking at the BCS-model of superconductivity.

After Rudolf had invited me to spend a year in Urbana, he confronted me with several a priori unrelated insights, one of them based on the postulate that King Solomon could not decide between two physicists working with “physically equivalent representations” of the same C*-algebra. After months of inconclusive investigations of his claims, I had the luck of finding a theorem of Fell in the bibliography of Guichardet’s thesis (which