

Siegfried Grossmann: the Great Man, our Teacher

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The heavenly setting

When a man reaches the age of 75, it is allowed if not appropriate to call to mind the beautiful words of wisdom from the 90th Psalm – even if the man is Siegfried Grossmann and shows no sign of getting weak or less undertaking than ever. His life has been and continues to be rich and dense, blessed with challenging activity, with earned friendship and far-reaching influence (in space and time). We seize the opportunity to express our gratitude for every minute that we were privileged to enjoy his company.

It was an honor and great pleasure that Marko Robnik assigned us to share with the participants of his wonderful conference on Nonlinear Dynamics some memories of our times with Siegfried Grossmann, and our perspective as his former PhD students: one (P. H. R.) from the early times around 1970, the other (D. L.) from the period of maturity some twenty years later.

We would not have known much about the first half of his life had we not consulted with the Heavens and obtained relevant information from there. We followed the course of the planets through Siegfried's life and discovered an undisputable correlation between Saturn's pace and his. It takes Saturn 30 years to complete a cycle through the zodiac, and we shall show how this is reflected in Siegfried's epochs. Remember that Saturn's name in Greece was Kronos: he sets the cosmic time stan-

dard – a god not aiming for power like Jupiter but for wisdom and order.

Siegfried Grossmann was born on February 28, 1930, in a village near Königsberg. At that time Saturn was visiting Sagittarius, the archer, while Jupiter, on the opposite side of the sky, associated himself with Taurus, the bull. Everybody knows from his affair with Europa how much Jupiter loved to be a bull himself; nothing like that has been reported of Siegfried. On the other hand, combining wisdom with the skills of an archer in order to find the right arguments and place them precisely to the point: that is one of his characteristic strengths.

The family left Königsberg shortly after Siegfried was born, and moved to Berlin. So he did not see the destruction of his home town but instead witnessed the collapse of Germany's capital as a boy of age 15. Of course this also meant the end of terror in Germany, and only this liberation made all what followed possible. Saturn, at the low point of his cycle, has finally won his struggles with the ram and the bull and is just about to leave Taurus' house, looking ahead to better times.

The second epoch of 15 years are formative years. 1948 Siegfried finishes high School and begins to study at a Pedagogical High School, a teacher training for elementary school. He finishes this in 1951 and starts to study physics and mathematics at the Free University of Berlin, aiming at becoming a high school teacher. In 1955 he starts to teach,

two years as “Referendar”, then one year as “Assessor”, the starting ranks in the German hierarchy of a teacher’s career. At the end of this time he has developed his incomparable skills as a teacher, never to lose them again. Only then does he feel prepared to turn all his attention to science. Günther Ludwig invites him to be his assistant, and within a year, at age 30, he earns his doctoral degree.

At that point he is married to Marga. In 1959 his first son Christian was born. Marianne followed 1961, Peter 1966. Saturn has finished a full cycle and returned to Sagittarius where he meets Jupiter who has completed two and a half turns. Together they work out a plan for a brilliant future.

inspite of tempting offers from other institutions. One of us (P.H. R.) joined his group in that memorable year of 1968. He had been traveling through Germany, visiting a number of universities in search for a good place to do a PhD thesis. When lucky circumstances led him to meet and discuss with Professor Grossmann, there was no doubt he would stay in Marburg. The very same experience, some twenty years later, attracted the other one (D. L.) into Siegfried’s institute at Renthof 6. For both of us, this was one of the best decisions in our lives.

The graphic rendering of Siegfried’s scientific activities in Fig. 1 shows that near the end of the sixties, he widened his interest from transport theory to the theory of phase transitions. At that time, there was a widespread feeling among statistical physicists that a breakthrough in the understanding of critical phenomena was around the corner. Siegfried pursued the line of Yang and Lee and studied the distribution of complex zeros of the canonical partition function. As everybody knows, the solution came in 1971 when Kenneth Wilson applied renormalization theory to the scaling ideas of Leo Kadanoff and Michael Fisher – an achievement that Siegfried greatly admired. That problem being solved, he looked for new challenging fields of research. Non-equilibrium phase transitions were the obvious next topic, such as the laser threshold and: the transition to turbulence.

Turbulence! It took a lot of courage and self-confidence to enter a field which giants such as Heisenberg and Kolmogorov had considered to be one of the most difficult parts of physics. But Siegfried was determined, early on, to make it the main theme of his life as a scientist. By 2002 he had written 88 papers on the matter (by his own attribution of his papers to subjects), and has become the undisputed leader in the field – in Germany for sure, most certainly in Europe, and equal in rank with only a few others in the world. As the above graphic shows, it took him a while to take off. His first paper on turbulence from 1971, “Turbulent transport equations and Kubo formulae for eddy transport coefficients” (*Z. Naturforsch.* 26a, 1782-1791 (1971)), was still a link between his previously acquired expertise in transport theory and

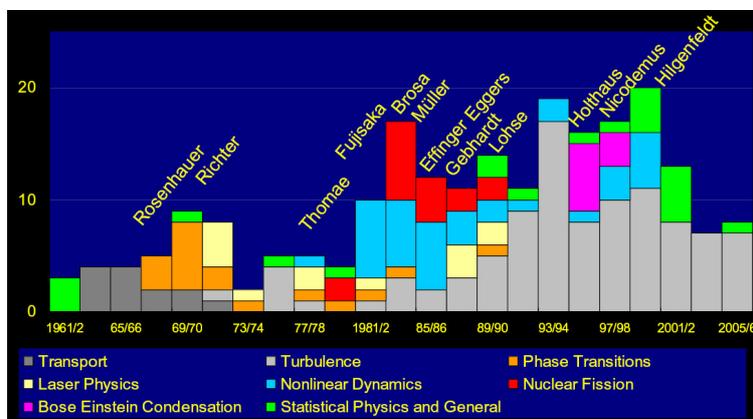


FIG. 1. Spectrum of S. Grossmann’s scientific articles, at a resolution of 2 years, from 1961/62 through 2001/02. The number of papers is given by the height of a column. Colors code for fields of research: general statistical physics (green), transport theory (dark grey), phase transitions (orange), laser physics (light yellow), turbulence (light grey), nonlinear dynamics (blue), nuclear physics (red), Bose-Einstein condensation (magenta). The names refer to coworkers in Marburg with whom S. G. had at least 4 joint publications.

Saturn’s second cycle

Siegfried’s career develops swiftly. Habilitation in 1962 (with work on quantum mechanical transport equations), an appointment at the Technical University of Munich (1963), Extraordinary Professor at the University of Marburg 1964, “Personal Ordinary Professor” 1966, finally Ordinary Professor 1968, all in Marburg where he has stayed ever since

his new love. A period of breeding followed where he developed the vision that ideas from renormalization theory ought to be a promising new idea to understand and quantitatively describe the scaling of eddies in energy dissipation. That's why his output in terms of number of papers came to a low point at the end of his third epoch. Saturn, midway in his second cycle, had to pass the bull's house again.

The outbreak started in 1975, with students like Erwin Schnedler, Stefan Thomae, Hirokazu Fujisaka – still not completely focused on turbulence: nonlinear dynamics came in as a new and exploding activity, starting with the seminal Grossmann-Thomae paper “Invariant distributions and stationary correlation functions of one-dimensional discrete processes” (*Z. Naturforsch.* 32a, 1353-1363 (1977)). This paper, though it got tremendous attention, would have deserved even more. It analyzed the period doubling scenario of the logistic map to unprecedented depth, including the first published value of the scaling exponent, the discovery that it applies on both sides of the accumulation point of the period doubling, and a correlation analysis for the chaotic attractors at Misiurewicz points. Another sidetrack in those years were contributions to nuclear fission: an application of ideas from hydrodynamics to the physics of heavy ion collisions (with Ulrich Brosa and Andreas Müller).

When turbulence took over as the prime activity in the middle of the eighties, it was supported by an excellent team of young people, notably Hans Effinger and Jens Eggers. The paper “Static structure function of turbulent flow from the Navier-Stokes equations” by Effinger and Grossmann (*Z. Phys. B* 66, 289-304 (1987)) was particularly influential: it is full of beautiful ideas and very nicely reveals the essentials of fully developed turbulence. Not only does it give a natural derivation of the different scaling regimes, but with this method they succeeded to directly calculate the Kolmogorov constant from the Navier-Stokes equation, of course in some approximation. As a newcomer around 1990, D. L. found this paper to be the most illuminating entrance to the fascinating world of turbulence.

The fifth epoch

By 1990, Saturn again with Sagittarius, Siegfried has reached the point of his career where the harvest can be collected: his scientific contributions earn him worldwide recognition; his matchless talent as teacher and his superior skills as moderator, councillor, referee, editor, evaluator earn him respect and admiration on all levels – from students to colleagues to professional organizations up to the federal minister of research and technology who appoints him to be chairman of a high ranking advisory committee for developing guidelines of the German federal policy in matters of science and technology (1990-92). This work had far-reaching implications for the direction of basic and applied research in our country.

Siegfried is invited into several academies: the European Academy of Sciences and Arts (1991), the Berlin-Brandenburgische Akademie der Wissenschaften and also the Deutsche Akademie der Naturforscher Leopoldina in Halle (both 1994). He is awarded highly prestigious prizes: the Max Planck-medal of the German Physical Society (1995), the Großes Verdienstkreuz des Verdienstordens of the Federal Republic (1996), the Karl Kupfmüller-Ring of the Technical University of Darmstadt (1997). He acts on many influential committees, including some that award prizes to students and scientists on all levels, most notably the Leibniz- and the Karl Heinz Beckurts-Prize. As a special honor, he is elected first Ombudsman of the German Science Foundation DFG, in recognition of his own impeccable integrity and his unsurpassed ability to handle conflicts.

Siegfried would not be himself if any of this could distract him from his prime concern with science. Fig. 1 proves that his activity continues to flourish – to this very day. We are proud to still be part of it. His attitude in doing science has not changed since we first met him: long and intense sessions at the blackboard that we both gratefully recall as the most effective part of our education as physicists. It was pure intellectual pleasure to see him come to the heart of a problem immediately, and to work it out in detail. He is not driven by any formalism

although he masters them all; his interest is finding a physical explanation of observed phenomena, simple or complex. An impressive recent example is his beautiful article “Hundert Jahre Grenzschichtphysik” (Physik Journal, October 2004) where he uses the opportunity of the 100th anniversary of Prandtl’s first paper on hydrodynamics to explain why an airplane can fly.

At the end of his fifth epoch, tireless as he is, he has started a new initiative: to improve the education of physics teachers in Germany. Using all the weight of his reputation he has put an enormous effort in convincing German authorities to give special attention to an appropriate teacher training *sui generis*. The heavens have more in stock, we are sure, for his sixth epoch, to the benefit of all of us.

Thinking of Siegfried, the planets and stars remind us of Immanuel Kant with whom he shares not only the birthplace but also many standards and virtues: as teacher, thinker, and as a man of wisdom and influence.