SOME MEMORIES OF TINI VELTMAN*

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I never worked with Tini Veltman, but we were good friends throughout our time together at CERN. One of my earliest memories of him is the picture of Snoopy that he generated on the computer. My children called him the "Snoopy Man". About the same time he rescued me when I got my computer cards mixed up. Those were the days when we had to punch cards and then feed them onto the computer, and I was always making mistakes. Then one day he charged into my office to lecture me: I should be at home taking care of my children instead of putting them in someone else's care. The irony is that many years later, when I was at Berkeley, and he at Michigan, his daughter Helene was doing Ph.D. work in particle experiments and became very frustrated with it. So Tini said: "Why don't you go to Mary K?". She did and became my Ph.D. student. We had already become something of a family one summer when Bruno and I were visiting FermiLab and Helene was working there. We often invited her to dinner and we went to the movies together.

Tini and I had many conversations over the years, about physics, physicists and life in general. Tini was extremely critical, especially about people, but also very discerning. I very much enjoyed our interaction. One day my close friend Nan Phinney and I took him out to lunch.

Tini was the first to recognize the importance of the electroweak threshold and predicted that some new physics had to show up at an energy less than a trillion electron volts (TeV). Thirty years ago, I gave a talk at his 60^{th} birthday celebration in Ann Arbor, Michigan [1]. My talk was on thresh-

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olds and effective theories in particle physics which was published in the proceedings. I cited Tini's work in the section on the electroweak threshold, which by then was understood as associated with the W and Z bosons, the mediators of weak interactions.

The last section of the talk was devoted to effective supergravity theories from string theory, which is what I have been working on in recent years. I calculated the leading one-loop corrections to these theories and their linear and chiral anomalies. Below, I will briefly describe my results with my recently graduated student Jacob Leedom [2, 3] for effective theories from Z_3 and Z_7 orbifolds, with and without Wilson lines; the latter allows for matter particles from the so-called "twisted sector" of string theory.

We showed that, by introducing appropriately chosen Pauli–Villars fields to eliminate the ultraviolet divergences, it is possible to eliminate all anomalous terms except for those that can be canceled by a Green–Schwarz (GS) term analogous to the well-known GS term that cancels the anomaly associated with the terms bilinear in Yang–Mills gauge fields. If there are no Wilson lines the procedure is fairly simple, but the spectrum does not contain all the partciles of the Standard Model. When Wilson lines are present, there are many more particles, including those we observe at presently accessible energies. However regularization of these theories requires a large number of PV particles. One example of a fully regulated theory of this type is displayed in our paper.

The attractiveness of string theory is that its low-energy limit provides the only presently known example of a finite field theory. I doubt that Tini ever read any of these papers; if he had, he no doubt would have been appalled at what I was working on. Tini was highly skeptical of string theory.

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