the red oxide. In this plant there were huge vats filled with rare earths in varying states of separation by fractional recrystallization. They were extremely beautiful with their typical delicate colors. It was at Lindsay Light and Chemical that the first uranium dioxide was made and brought back to the University for Fermi to use in one of his early experiments.

In the late winter of 1941-42, McCoy advised Compton that he needed someone who knew something about rare earths to guide the chemistry effort. He named Frank Spedding who came to Chicago in March 1942. Spedding was the first director of the Chemistry Division, which was organized into the four sections that Glenn Seaborg has just mentioned. Glenn, Charles Coryell, Milton Burton, and I were the four individually responsible for these sections.

As the person responsible for analytical chemistry, I came into direct contact with the physicists on the Plutonium Project. They were interested in obtaining extremely pure uranium and extremely pure graphite. Fermi was building one "criticality experiment"* after another in the handball court under the West Stands of Stagg Field. The reproduction factor, k, kept going up–0.96, 0.97, 0.98, etc.–as increasingly pure uranium oxide or metal and graphite were used in his experiments. The levels of purity required seemed fantastic and there was the need to analyze for impurities at part-per-million concentrations. The field of trace analysis in analytical chemistry had scarcely been developed, and we had the job of not only analyzing for many unaccustomed elements as impurities, but also doing it at levels that had never been attempted before.

Professor Compton asked our section to work with the Mallinckrodt Chemical Company in St. Louis whose chemists had devised an ether extraction process for the purification of uranium. A method was needed to show that this solvent-extracted uranium had a high degree of purity.

One of the greatest assists we got was with a nonchemical procedure devised by Fermi. This was the so-called "shotgun" method wherein a kilogram of uranium was extracted and the impurities were collected and measured in aggregate. It was described as shotgun because it measured all the impurities at once. Even with the purest of uranium, if you extract a kilogram you will recover a milligram to a fraction of a gram of impurity. These impurities were pressed into a pellet and placed in a paraffin geometry with a radium-beryllium source. The

*Criticality describes the state of a nuclear reactor when it is sustaining a chain reaction.