1. Introduction.

When I accepted the invitation to give this presentation to an assembly of young scientists at the Nobel Symposium 91, I had not realized the complexity of the task at hand. Soon enough I found myself wandering in a forest which I could not see because of all the trees around me. But then this exact analogy opened up a view on this field which I will use to carry us on a quick, but nevertheless enjoyable, and hopefully coherent, roller coaster ride through the history of ion traps .

The angle of view I am referring to is based on the discussions in Michael McGuire's (a long standing, respected member of the "Trap Community" himself) book "An Eye for Fractals" [1]. He shows how with a minimal symmetry and very basic branching rules we can grow a wonderful tree from just a few small branches: "From a trunk grow two branches. The length of the branches are to be less than the length of the trunk, and the angles between the line of the trunk and the branches are given. Here we have a branch at 10°, 9/10 the length of the trunk and one at 60°, 6/10 the length of the trunk. Now treat the branches as trunks and do the same branching again at their ends. If at the first iteration we rotate the planes of these new branchings by 90°, the figure becomes three-dimensional". Figure 1 shows the result after only 10 iterations according to these rules. The resulting tree exhibits a level of symmetry and structure which is also present in the now very divers field of ion traps in the sense that even the smallest part displays a very close relation to both the origins as well as to other portions of the field, while at the same time the whole is more than just the sum of the parts.

This excursion through our field is not meant to be a rigorous and complete historical study, nor can it do justice to all the exciting experiments presently being performed in this area. I simply chose a few, very specific examples to make the point that based on the simple ideas of the original authors of long confinement times and perfect isolation for charged particles a very exciting area in physics has been developed. Due to the limited scope of this discussion I will only present the RF quadrupole traps (Paul traps) and the Penning traps, but not trapping schemes like the Kingdon trap, combined traps, and magnetic bottles. Also, while a charged particle may be represented by any entity which exhibits a non-zero charge to mass ratio, I will concentrate on the work on charged elementary particles and on ions, and will not discuss the broad field of trapping of macroscopic, particles, clusters, macro-molecules, etc.